

Status, ecology and management of the brown bear (*Ursus arctos*) in Slovakia

R. Rigg and M. Adamec



Status, ecology and management of the brown bear (*Ursus arctos*) in Slovakia

R. Rigg¹ and M. Adamec²

¹ SWS – Slovak Wildlife Society
P.O. Box 72, Liptovský Hrádok 033 01, Slovakia
Tel.: +421-(0)44-5293752 | e-mail: info@slovakwildlife.org
www.slovakwildlife.org | www.medvede.sk

² State Nature Conservancy of the Slovak Republic
Lazovná 10, P.O. Box 5, Banská Bystrica 974 01, Slovakia
Tel.: +421-(0)48-4713622 | e-mail: michal.adamec@sopsr.sk



- Citation:** Rigg R. and Adamec M. (2007). *Status, ecology and management of the brown bear (Ursus arctos) in Slovakia*. Slovak Wildlife Society, Liptovský Hrádok. 128 pp.
- Publisher:** SWS – Slovak Wildlife Society, Liptovský Hrádok, Slovakia.
- Copyright:** © 2007 SWS – Slovak Wildlife Society
- Reproduction of this publication for education, research, conservation and other non-commercial purposes is authorised without prior written permission from the copyright holder provided the source is fully acknowledged.
- Reproduction of this publication for resale or other commercial purposes is prohibited without prior written permission of the copyright holder.
- Authors:** R. Rigg and M. Adamec
- Photography:** R. Rigg
- Acknowledgements:** Several people assisted in the preparation of this report by providing papers or information and commenting on drafts. In particular the authors wish to thank J. Swenson, R. Morley, L. Paule, M. Kassa, M. Jób, K. Soóš, D. Huber and V. Čičmanec for their contributions.

PREFACE

As part of *The BEARS Project*¹ – *Bear Education, Awareness and Research in Slovakia* – the Slovak Wildlife Society was commissioned by WWF in 2005 to write a report on the status of bears in Slovakia. Given this task, I decided not only to examine current management regimes but also to thoroughly review the state of existing knowledge.

The recovery of the brown bear in the West Carpathians has not escaped the attention of either experts or the public. Hundreds of articles about them have been written in Slovak in the popular press, in hunting magazines and wildlife management journals. And yet the number of good quality scientific papers published is small, very little robust research has been done using modern methods and the participation of Slovak wildlife researchers and managers in the leading international initiatives, networks and events has been sporadic. As a result, relatively little is known about Slovakia's bears.

Some of this report is a synthesis of previously published material in an effort to make it more complete and accessible. Scattered observations have been compiled into data sets and statistically analysed to produce original results. Whilst wishing to avoid the mistake of deriving quasi-precise conclusions from inadequate data, I have tried to critically evaluate as much material as possible from a broad range of sources. Although they were not always presented with the clarity and rigour of good scientific studies, valuable information was gained from observations of foresters and hunters. Use was made of the extensive, but largely unpublished, records held at the State Nature Conservancy in Banská Bystrica.

The task was complicated by the many inconsistencies and unsubstantiated claims among sources. I have highlighted where commonly held assumptions appear to be incorrect or are not supported by available evidence, where sources contradict each other and where important information is most lacking and more work is particularly needed.

The bear population in Slovakia is now large enough, and hunting pressure low enough, for it to be in no short-term danger of extinction. However, there are clearly deeply divided opinions on how it should be managed. Much of the debate has focussed on how many bears there are and to what extent they can or should be hunted. From a conservation perspective, however, there are issues of more pressing concern. Fragmentation, degradation and loss of habitat, especially by the continued development of mountain areas and the construction of highways, could lead to greater problems for bears in some parts of Slovakia in the not too distant future. If bear-human conflicts are not sufficiently mitigated, they might undermine public support for bear conservation.

This report therefore comes at an opportune moment. I hope that it will help improve our understanding of bears, their ecology and interactions with humans and, in particular, that it will contribute to conservation through the elaboration of a bear management plan for Slovakia.

I would like to thank WWF Denmark and the Danube-Carpathian Programme for the opportunity to prepare this report and for their patience in waiting for its completion. My sincere thanks also go to those people who contributed to its compilation.

Robin Rigg
Slovak Wildlife Society
Liptovský Hrádok, June 2007

¹ <http://www.medvede.sk>

SUMMARY OF MAIN FINDINGS

The brown bear is the most numerous large carnivore in Slovakia. There has been only limited research on numbers, but the results available suggest a total of 770-870 individuals inhabiting a range of around 13,000 square kilometres. Genetic effective population size is unknown. The age-sex structure has not been sufficiently studied and there has been no detailed research to determine the age at which females produce their first litter, how often they breed, the average litter size and how many cubs survive. Social organisation, dispersal, habitat selection and home range are also poorly understood.

More than 90 percent of bears in Slovakia belong to the West Carpathian sub-population, which extends into Poland and the Czech Republic. Individuals in the extreme northeast of the country represent the western edge of the East Carpathian sub-population in Poland and Ukraine. No comparative genetic study has been carried out on these two sub-populations. It is likely that exchange of individuals between them is weak and further study is desirable. Due to the transboundary nature of the bear population, close international co-operation between governments, state agencies and scientists in Slovakia, Poland, the Czech Republic and Ukraine is important with regard to management. To date, co-operation has generally been poor and should be developed.

Numbers of bears and possibly occupied range appear to be increasing, mainly in peripheral areas, despite legal hunting and poaching. The West Carpathian sub-population is still recovering from a low of 20-60 individuals in the 1930s caused by trophy hunting and persecution. According to expert estimates, the average population growth rate during the period 1932-2005 was 4.5% annually, which is comparable to other expanding populations in Europe.

Bear distribution is closely related to forest cover and elevation, which are both inversely correlated to human settlement and activity. Besides deciduous, mixed and coniferous montane forests, important habitats for bears include sub-alpine and alpine meadows as well as open areas with food sources at lower elevations. Habitat is rather fragmented due to topographic characteristics of the landscape resulting in mountain ranges with prime bear habitat separated by areas of denser human settlement in broad river valleys. As a consequence, bear distribution is patchy. If measures are not taken, fragmentation of habitat is likely to worsen due to highway construction, the expansion of tourism infrastructure and other development.

Population density appears to reach 5-11 bears per 100 square kilometres in core areas such as Malá Fatra, Veľká Fatra, Nízke Tatry, Západné Tatry and Poľana. All these mountain ranges are wholly or partially included in protected areas and have also been proposed for designation as Natura 2000 sites. However, protected areas in isolation cannot sustain viable populations because they are not large enough for such a wide-ranging species and do not encompass whole ecosystems. To prevent permanent isolation and fragmentation of the West Carpathian sub-population, it is essential that bears continue to be able to move between core areas, which will mean tolerating bear presence in areas of higher human activity and settlement. Adequate connectivity can only be maintained if land-use planners are required to respect habitat linkages identified in national and international ecological networks.

The brown bear in Slovakia is both a game species and protected by national and international legislation. Management is mainly at national level and is overseen

by the Environment Ministry and the Agriculture Ministry, which have highly contrasting approaches. The former views hunting mainly as a tool to reduce conflicts and sets quotas as maximum limits, whilst the latter regards population control as essential and sees quotas as hunting plans to be filled. This division of management has led to strife and failure to implement important conservation recommendations. Valuable income from trophy hunting has also resulted in conflict over management.

Over 1,300 bears have been shot since limited hunting was reintroduced in 1958. Many experts believe that male-biased trophy hunting in the 1960-80s altered the population's age-sex structure. Regulations were tightened and the proportion of males in the legal harvest fell from 79 percent in 1958-80 to 62 percent in 1994-2005. Legal hunting accounts for 72 percent of known mortality but is probably below maximum sustainable yield, estimated at 8.5 percent of the population, currently 70 bears per year. Even before strict regulations were imposed, quotas were not usually filled. For a variety of reasons, hunter success has shown a downward trend since 1992.

Restrictions on hunting are unpopular with hunters, particularly the banning in 2000 of spring hunting, the use of carcasses as bait and shooting bears weighing more than 100 kg. The weight regulation is quite frequently violated: of 155 bears shot in 2000-05, more than a third weighed over 100 kg. Hunting advocates claim that the ban on killing larger bears has resulted in only juveniles being targeted. In fact, 70 percent of bears shot in 2003-05 were at least 4 years old, i.e. potentially sexually mature.

During communism, hunting managers considered 300-400 bears to be "*optimal*". Despite major changes likely to favour bears and reduce conflicts, such as a decline in livestock grazing in mountains, pro-hunting advocates still adhere to this figure. In contrast, favourable conservation status within Natura 2000 has been defined

by the State Nature Conservancy as at least 500-800 individuals, which is more in line with current status, biological carrying capacity and public attitudes.

Damage to agriculture by bears is negligible on a national scale, but can be of local significance. Since 1962 there has been a state-run compensation scheme for losses of livestock and damage to beehives and this was recently expanded to include other forms of damage. There are cases of bear attacks on people in most years, some resulting in severe injury, but there have been no recent deaths. Almost all attacks are either defensive or by food-conditioned bears. Conflicts are highly publicised by the media, influencing public opinion. The hunting lobby has used them to call for increased control of bear numbers.

Public knowledge about bears and bear safety is poor and preventive measures to reduce damage to property are not widely used. Hunting advocates and some sectors of the media promote hunting as the sole method of bear management. Lobbying by radical environmentalists and animal rights activists against any killing of bears and disturbance of their habitats can also be misleading and counter-productive to bear conservation. More objective education initiatives have been limited by a lack of detailed research on bears in Slovakia.

Ensuring that the brown bear is maintained at a favourable conservation status calls for the following actions:-

- adequately protecting core habitats;
- identifying, maintaining and improving movement corridors and linkages;
- tolerating bear presence in some areas beyond core habitats;
- continuing to regulate hunting strictly;
- placing less reliance on lethal control and more on using preventive measures;
- carefully monitoring population trends;
- conducting more research on bear ecology and key population parameters;
- providing accurate information in wide-reaching, credible education initiatives.

CONTENTS

Preface	1
Summary of main findings	2
Contents	4
List of tables and figures	6
Introduction	8
1. Status	10
1.1. Biological	10
1.1.1. Genetics	10
1.1.2. Biometrics	11
1.1.3. Distribution	13
1.1.4. Numbers	16
1.1.5. Density	18
1.1.6. Population trend	20
1.1.7. Age-sex structure	24
1.1.8. Recruitment and mortality	26
1.2. Legislative	34
1.2.1. International	34
1.2.2. National	38
1.3. Socio-economic	39
1.3.1. Danger to humans	39
1.3.2. Economic impact	41
1.3.3. Attitude, opinion, knowledge	45
1.4. Threats to bears	46
<i>Summary and evaluation of status</i>	<i>51</i>
2. Ecology	52
2.1. Habitat	52
2.2. Diet	55
2.3. Hibernation	55
2.4. Home range	57
2.5. Activity	58
2.6. Reproduction and survival	59
2.7. Social organisation, dispersal	61
2.8. Parasites, diseases, pollutants	62
<i>Summary and evaluation of ecology</i>	<i>63</i>

3. Management	64
3.1. Responsible authorities	64
3.2. Conservation action plans	65
3.3. Habitat protection	66
3.3.1. Protected areas	66
3.3.2. Ecological networks	69
3.3.3. Restoration/recovery	72
3.4. Species protection	73
3.5. Hunting	74
3.5.1. Historical overview	74
3.5.2. Present situation	82
3.5.3. Future perspectives	86
3.6. Conflict mitigation	89
3.6.1. Non-lethal prevention	89
3.6.2. Compensation	91
3.6.3. Lethal control	93
3.6.4. Other aspects	95
3.7. Bears in captivity	96
3.8. Research	99
3.9. Education	101
<i>Summary and evaluation of management</i>	<i>102</i>
Conclusions and recommendations	104
References	106
Appendices	121
I: IUCN action plan recommendations and implementation	121
II: Council of Europe action plan recommendations and implementation	122
III: Nuisance bear conference recommendations and implementation	123
IV: Official procedures for planned population control (<i>“regulation shooting”</i>)	124
V: Official procedures for paying compensation and removing problem bears	126
VI: Assessment criteria for the brown bear defined by the State Nature Conservancy in its manual for a programme of care for Natura 2000 sites and species	127
Abbreviations	128

List of tables and figures

Tab. 1.1. Body measures of bears ≥ 10 years old shot in Slovakia	11
Tab. 1.2. Comparison of official estimates of bear numbers and census results	16
Tab. 1.3. Expert estimates of bear numbers by mountain range in 1967 and 1999-2005 ..	17
Tab. 1.4. Comparison of estimates of bear numbers by region in 1985 and 2000-02	22
Tab. 1.5. Social structure of some local communities of bears in comparison to a range-wide census as estimated by direct observations or tracking in snow	25
Tab. 1.6. Size, age and sex structure of bear communities	25
Tab. 1.7. Causes of known bear mortality in Slovakia from 1994 to 2005	27
Tab. 1.8. Discrepancy between expected and observed population growth	32
Tab. 1.9. Summary of main legislation dealing with brown bears in Slovakia	37
Tab. 1.10. Reported damage to beehives and livestock during the period 1966-2005 ...	42
Tab. 1.11. Fees currently advertised for bear hunting by the State Forestry Service	44
Tab. 2.1. Forest types and percentage cover by vegetation level and altitude	52
Tab. 2.2. Litter sizes of local bear communities compared to a range-wide census	59
Tab. 3.1. Overview of large and small protected areas in Slovakia in 2005	68
Tab. 3.2. The 10 largest proposed sites of Community importance for the brown bear ..	71
Tab. 3.3. Overview of the two systems of bear hunting management in Slovakia	81
Tab. 3.4. Regional distribution of bears, hunting quotas and compensation payments ...	94
Tab. 3.5. Number and fate of motherless bear cubs found in 1995-2007	96
Tab. 3.6. Examples of motherless cubs found, management actions and outcomes	97
Fig. 1.1. Confirmed occurrence of bears in the West and East Carpathians since 1963 ...	9
Fig. 1.2. Brown bear distribution in Slovakia in 2005	14
Fig. 1.3. Average bear density in Slovakia by administrative region	18
Fig. 1.4. Bear numbers according to expert estimates and official hunting statistics	20
Fig. 1.5. Bear mortality by hunting and other causes from 1994 to 2005	26
Fig. 1.6. Causes of known bear mortality in Slovakia from 1994 to 2005	27
Fig. 1.7. Monthly distribution of bear mortality by “ <i>regulation shooting</i> ” in 2000-05 ...	28
Fig. 1.8. Monthly distribution of bear mortality due to removal of problem bears in 1998-2005 and self-defence shooting in 1997-2006	28
Fig. 1.9. Weights of shot “problem” bears feeding on refuse versus livestock/beehives ..	29
Fig. 1.10. Monthly distribution of known bear mortality due to causes other than legal hunting, self-defence and vehicle collision in 1997-2005	30
Fig. 1.11. Monthly distribution of bear mortality due to vehicle collision in 1997-2005 ..	30
Fig. 1.12. Yearly distribution of bear mortality due to vehicle collision in 1994-2006 ...	30
Fig. 1.13. The proportions of bears by weight category killed by vehicles, shot as problem individuals and estimated in the general population	31
Fig. 1.14. Total annual compensation payments for damage by bears since 1965	41
Fig. 1.15. Trends in hunters’ reports of damage by bears	42
Fig. 1.16. Category and amount of compensation paid for damage in 1995-2006	43
Fig. 2.1. Forest cover and bear occurrence in Slovakia since 1963	53
Fig. 2.2. Altitude zones and bear occurrence in Slovakia since 1963	53
Fig. 3.1. Existing and proposed large protected areas in Slovakia in 2006	68
Fig. 3.2. Proposed sites of Community importance for the brown bear in Natura 2000 ..	71
Fig. 3.3. Sex ratio of 1,144 bears legally shot in 1958-2005	77
Fig. 3.4. Sex ratio by weight of 410 bears shot in 1994-2005	77
Fig. 3.5. Annual variation in the number of bears shot in Slovakia in 1968-2006	77
Fig. 3.6. Sex, age and weight categories of bears shot in 2003-05	84
Fig. 3.7. Correlations between bear numbers, hunting and compensation payments	94



INTRODUCTION

For a variety of reasons, detailed information from Slovakia has not been included in many case studies of the conservation management of the European brown bear (*Ursus arctos*). While Slovakia has not so far been a place of leading scientific research on bears and other large mammals, it offers a wealth of practical experience in the hands-on management of problematic species. Slovakia is an instructive example of early carnivore conservation measures, including attempts at population augmentation 100 years ago and a damage compensation scheme that has been running since 1962, of ongoing consequences decades after population recovery and of the outcomes of different ploys to reconcile trophy hunting with conservation of a rare species.

Excessive sport hunting and persecution in the 19th and early 20th centuries almost eradicated bears from Slovakia. By the 1930s, contemporary estimates of the number surviving ranged from about 20 to not less than 60 (references in Halák 1993). Sometime between 1908 and 1930 the occupied range became fragmented, leaving an isolated population in the West Carpathian Mountains of central Slovakia and southern Poland (Jamnický 1993).

A ban on hunting from 1932 protected the few remaining bears and allowed a natural population recovery. Although this was the only broad-scale measure taken with the specific intention of conserving bears in Slovakia (Martínková and Zahradníková 2003), several other concurrent factors probably helped, including the expansion of forest cover, recovery of large ungulates and wolves *Canis lupus* (Voskár 1993), a marked decline in livestock grazing, abandoning of fields and orchards in mountain areas and perhaps supplementary feeding by hunters (Rigg and Gorman 2006a).

The number and range of bears in the West Carpathians increased rapidly in the second half of the 20th century. Brown bears had reoccupied all central mountain ranges of Slovakia by 1950 and during the 1970s spread into some peripheral ranges (Janík 1997). Contact between bears isolated in the West Carpathians and the East Carpathian sub-population became re-established during the 1970-80s, initially in Poland (Jakubiec 2001).

Currently, the brown bear population in the Carpathians, which includes bears in Slovakia, Poland, Ukraine and Romania, has been estimated to comprise c.8,000 individuals, making it the second largest in Europe after that of the northeast (Swenson et al. 2000). Population size and distribution have continued to increase in the West Carpathians in recent years. A few individuals have been regularly present in neighbouring Czech Republic since the 1970s (Červený et al. 2004a) and according to Hell and Slamečka (1999) there have been occasional occurrences in Hungary (see Fig. 1.1).

Although population recovery has been a reality for several decades, Slovaks are still getting used to it. In general, the public tends to have neutral to positive attitudes toward bears, but most people are afraid of them and knowledge levels are low (Wechselberger et al. 2005).

Economic, political and language barriers have limited scientific research and publication on large mammals in Slovakia. So, too, has the influence of powerful lobbies with self-serving interests and established structures. Forestry and hunting have long, interwoven traditions in Slovakia. The brown bear is a game species and its management has therefore been dominated by hunting concerns. This situation is different from Poland, which shares the same bear population as

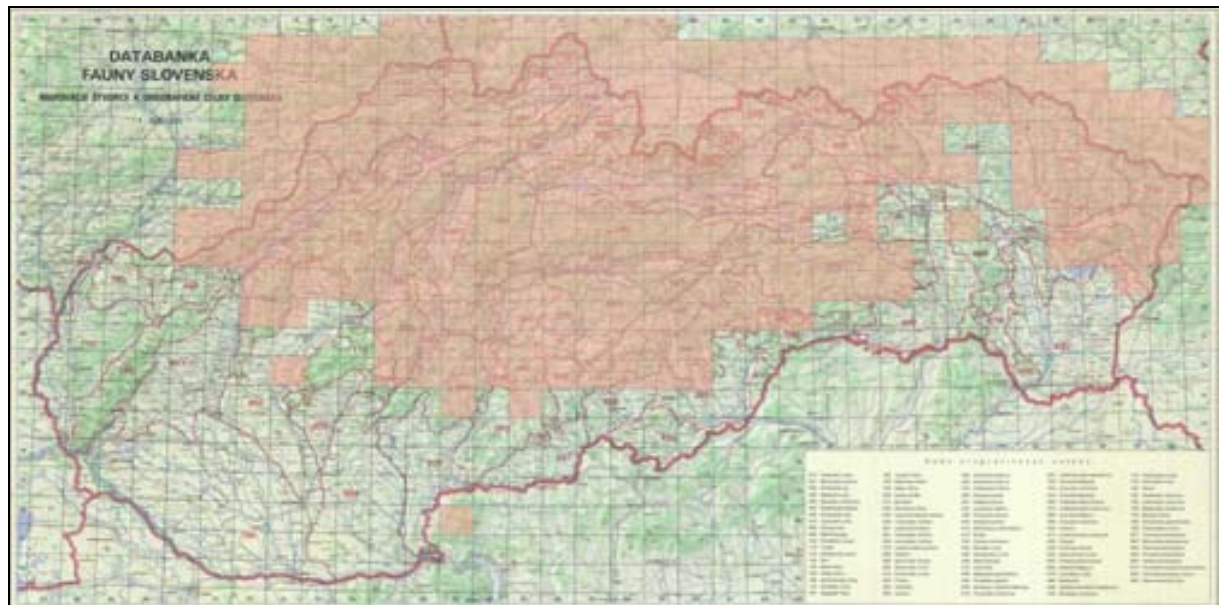
Slovakia but has had no legal harvest since the 1950s (Jakubiec 2001). There, the leading bear experts are nature conservation staff. Their work has focussed heavily on ecological research and practical measures to resolve bear-human conflicts. As a consequence, considerably more progress has been achieved in both these fields in Poland (see Rigg 2004b) than in Slovakia, where the paucity of modern scientific research on bear ecology is glaring.

This report aims to be a comprehensive, detailed and objective assessment of the status of bears in Slovakia, their historical and current management and the state of scientific knowledge about them. In some sections it also offers new information in

the form of original results. Some data from neighbouring countries sharing the population, as well as from elsewhere as appropriate, have been included for illumination and comparison, as well as to fill in gaps where data from Slovakia were unavailable or insufficient.

The territory of present-day Slovakia formed part of various different political entities until an independent Slovak Republic came into being on 1.1.1993. For the sake of clarity, in this report the territory encompassed by the country's current borders has been referred to as Slovakia throughout its history and in most cases the current names of institutes and organisations have also been used when referring to their equivalent predecessors.

Fig. 1.1. Confirmed occurrence of brown bears in the West Carpathian Mountains and the western portion of the East Carpathian Mountains. A survey square (10 degrees of longitude by 6 degrees of latitude or c.12 x 11 km = c.132 km²) is coloured pink if there has been at least 1 report of bear presence within it since 1963. Data may be incomplete: an unmarked survey square does not necessarily mean that the brown bear has not occurred there. Sources: Hell and Slamečka 1999, Jakubiec 2001, Martínková and Zahradníková 2003, Červený et al. 2004a, 2006, Databank of Slovak Fauna², Taxon and Habitat Information System³, unpublished data.



² <http://www.dfs.sk>

³ <http://www.sopsr.sk/istb>

1. STATUS

1.1. Biological

1.1.1. Genetics

Two distinct clusters of mitochondrial DNA (mtDNA) lineages, known as the Western and Eastern lineages, have been identified among European brown bears (Taberlet and Bouvet 1994). All bears from Slovakia included in analyses done in the 1990s and 2005 were identified as belonging to the Eastern lineage, which was also found to include bears from Romania, Russia, Estonia, Finland and northern Sweden (Randi et al. 1994, Taberlet and Bouvet 1994, Kohn et al. 1995, Paunović and Ćirović 2006). The Western and Eastern lineages are clearly separated in Scandinavia, whereas in Romania they overlap (Kohn et al. 1995). The Eastern lineage has been included in a larger grouping of brown bears, known as Clade III, which also includes bears from Asia and western Alaska (Waits et al. 1999).

Taberlet and Bouvet (1994) concluded that the Eastern and Western European brown bear lineages differed from each other by a mean pair-wise genetic distance of c.7% and estimated that they diverged c.0.85 million years ago, probably due to geographic separation during Quaternary cold periods. It was thought that bears recolonised the Carpathian Mountains and European Russia from a single refugium, probably in southeast Europe or Asia (Taberlet and Bouvet 1994, Kohn et al. 1995, L. Paule pers. comm.). The latest results available suggest that the European lineages may have separated much more recently than previously thought, with a common ancestor having lived c.170,000 years ago and the Western and Eastern lineages established c.70,000 and c.25,000

years ago respectively. The West Carpathian Mountains and possibly also the Great Hungarian Plain may have been either one of the northernmost refuge areas or an important corridor for bear movements during or after the last ice age (Sommer and Benecke 2005, Saarma et al. 2007). Genetics is a new and rapidly developing field of research, so further insights are likely to be forthcoming.

Most bears now in Slovakia belong to the West Carpathian sub-population, which was genetically isolated and reduced to around 20-60 individuals in the early 20th century. Populations that have passed through such a bottleneck would be expected to have reduced genetic variation. However, Hartl and Hell (1994) reported high levels of allelic variation in the nuclear DNA of 57 bears from the West Carpathians. A recent pilot study using tissue samples from 25 bears shot or killed in 2004 found levels of heterozygosity in nuclear DNA comparable to those in the Scandinavian population (Paule et al. 2006). According to Swenson et al. (2000), the average heterozygosity observed in the West Carpathian bear population is within the range commonly found in mammals.

Generally, nuclear DNA would be expected to show higher variation than mtDNA because it is passed on by Mendelian inheritance from both parents. MtDNA is only inherited from the mother and variation is produced by mutations, so *a priori* a population would not be expected to be mixed if it originated by, for example, postglacial migration from one refugium (L. Paule pers. comm.). On the basis of analysing mtDNA from 14 bears, Kohn et al. (1995) reported that "*the populations in southern Sweden and in Slovakia display no intraspecific variation*", though variation in the length

of a homopolymer of thymidine defined 4 different lineages among bears from Slovakia.

Presumably there is little genetic difference between the 2 sub-populations represented in Slovakia (West Carpathian and East Carpathian), as they were connected in the past and there is believed to have been interchange of individuals in recent years. In 1981 there was an attempt to reinforce the East Carpathian sub-population using 5 bears captured in the West Carpathians. Monitoring was incomplete and so the outcome is unknown (Pčola 2003). The assumption of similarity between the 2 sub-populations does not seem to have been tested scientifically.

Genetic material may have been introduced to the West Carpathian sub-population. To augment bear numbers for hunting, individuals from Romania were released in 1905-06 in Hrochoťská dolina, Poľana, in central Slovakia. According to Teren (1987a, p.83-84) as well as Hell and Findo (1999, p.97), 6 young bears, 2 males and 4 females, were released, whereas Hell and Slamečka (1999, p.14) mention only 2.

1.1.2. Biometrics

Bears in the West Carpathians tend to be of average to small size for the species (Tab. 1.1). This is not surprising for an inland population with little or no access to spawning fish and a relatively low proportion of meat in the diet (see 2.2). There are no skulls or furs from Slovakia among the top 10 brown bear trophies from Europe, 80% of which are from Romania, most of them shot by N. Ceausescu in the 1980s. The two best Slovak skulls, from a c.20 year old male found dead in 2004 (Kacerová 2005) and a bear shot in 1983, scored 62.82 and 62.61 CIC points respectively, compared to 69.47 for 1st and 66.32 for 10th placed European trophies respectively (Červený et al. 2004b). The best Slovak fur, from a bear shot near Liptovský Hrádok in 1987,

scored 367.90 CIC points, compared to 687.79 for 1st and 593.77 for 10th placed European trophies.

There are several records of large bears in Slovakia in the past. A bear killed on 2.12.1878 in Orava, northern Slovakia, weighed 356 kg after gutting (reference in Jamnický 1993). In Liptov, a bear weighing 345 kg was shot on 21.3.1966 (according to Teren 1987a p.87 the year was 1964) and a 348 kg bear was shot on 20.4.1970 (Karč 2007). On 7.11.1901, a 370 kg bear was killed by hunters in Gemer, southeast Slovakia. Records mention a female killed in the same region in 1883 that allegedly weighed up to 400 kg (references in Jamnický 1993), surprisingly large for a female European brown bear. According to Sumiński (1976), the world record for trophies from the European brown bear was held by a 400 kg, 240 cm bear from the East Carpathians displayed at the first international hunting exhibition in Vienna in 1910.

Tab. 1.1. Body measurements of bears ≥ 10 years old shot in Slovakia. Source: Hell and Sládek 1994.

	Male		Female	
	mean	max.	mean	max.
weight (kg)	170-190	328	140-160	209
length (cm)	170-190	218	160-185	199
height (cm)	95-109	130	92-98	112
hind paw ^a (cm)	23-26	28	21-25	26
fore paw ^b (cm)	14-17	18	13-16	17

^a Length. ^b Width.

The mean size of bears shot legally in Slovakia decreased by 29% from 142.5 kg in 1980-82 to 101.8 kg in 1989-91. In 1980-82, 35% of shot bears were large adults (fore paw width ≥ 15 cm) whereas in 1989-91 the equivalent figure was 13% (Hell and Sabadoš 1993). It is not known

to what extent the reduction in body size of shot bears was due to the selective removal of large animals and how much was caused by the introduction of quotas by weight category. Decreasing body size could also have been due to increased competition for food resources as population density increased (see Dahle et al. 2006a). However, there is anecdotal evidence to suggest that trophy hunting in the 1970-80s eliminated large old males from some areas (Jamnický 1988a). In Slovakia, brown bears usually continue to increase in size until the age of 12 or more years (Hell and Sládek 1994). This suggests that a lack of large bears is quite likely to be indicative of a scarcity of old bears, especially males, which tend to continue growing longer, are larger on average than females and achieve much larger maximum weights (see Tab. 1.1).

There is some evidence to suggest that the largest bears now tend to be found in areas where there has been little or no legal hunting for 15 years or more and disturbance by other human activities is relatively low, i.e. where bears are more

likely to survive to old age. Baláž (2002, 2003) believed that some males he saw in part of the Západné Tatry with no legal hunting since 1989 reached 350 kg. Two bears tracked by Pčola (2003) in Poloniny National Park (no legal hunting since 1988) had front track widths of 18 cm or more. An extremely large male trapped and radio-collared on the Polish side of the border (no legal hunting since 1952) was estimated to have weighed over 300 kg in spring (Z. Jakubiec pers. comm.). A 300 kg male was killed in southeast Poland 30 years earlier (Sumiński 1976).

In the long-term, the persistent removal of large individuals, giving smaller bears a selective advantage, could affect the evolution of the species (Swenson 2005). Some Slovak foresters/hunters (e.g. Kováč in lit., Halák 1993) believe that foraging on refuse would allow female bears to raise less fit young and so might affect the weights of adult bears and hence future population quality. Selectively protecting females with young cubs, while desirable from an ethical point of view, could have the same effect (Swenson 2005).

A male bear following a female at the beginning of June in the Western Tatras.



1.1.3. Distribution

Before the impact of humans intensified, bears were presumably found throughout virtually the entire area of present-day Slovakia. Wallachian shepherds began colonising mountain regions from the 15th century. They penetrated parts of the bear range previously little used by humans (Halák 1993), modifying habitats by deforestation to expand areas available for grazing as well as persecuting predators. Nevertheless, bears persisted in most forested upland areas at the start of the 20th century, when West and East Carpathian sub-populations were still connected (Jamnický 1993). Excessive sport hunting and persecution drastically reduced both numbers and range, by the 1920-30s leaving only a relict, isolated sub-population in the less accessible mountains of central Slovakia (Feriancová 1955).

Restrictions on hunting imposed in 1932/33 allowed natural population recovery. As numbers increased, dispersing bears started to reoccupy their former range. After the Second World War, bears occurred mainly in Veľká Fatra, Malá Fatra, Nízke Tatry, Oravská Magura, Západné Tatry, Vysoké Tatry, Belianske Tatry and Slovenské Rudohorie (Teren 1987a). To a large extent these mountain ranges still form the core area of the West Carpathian sub-population. By the 1960s there were bears in most forested upland areas of central Slovakia. During the period 1966-1985 the occupied range expanded 40 km to the west and 50 km to the east (Martínková and Zahradníková 2003 citing Janík et al. 1986). There were c.35 bears in southern Poland in the mid-1970s, some of which presumably had home ranges partially in Slovakia (Sumiński 1976, Jakubiec 2001).

Dispersing bears were recorded in what is now the eastern Czech Republic in 1946, 1963 and 1970, with more frequent observations from 1972 (Červený et al. 2004a). Signs of bear presence have been observed in Beskydy Protected Landscape

Area (PLA) almost every year since 1973, including females with cubs and the occasional discovery of winter dens (Bartošová 2001). The distribution of the sporadic and irregular occurrence of bears in the Czech Republic was most widespread in 1980-99. In 2000-03, bears seemed to be dispersing less widely than previously but a few individuals had become more permanently established (Červený et al. 2004a). Bear numbers in Poland were also higher in the 1980s and 1990s than previously (Jakubiec 2001). There seemed to be a contraction of occupied range in Slovakia after 1984, despite increasing numbers (Hell and Slamečka 1999).

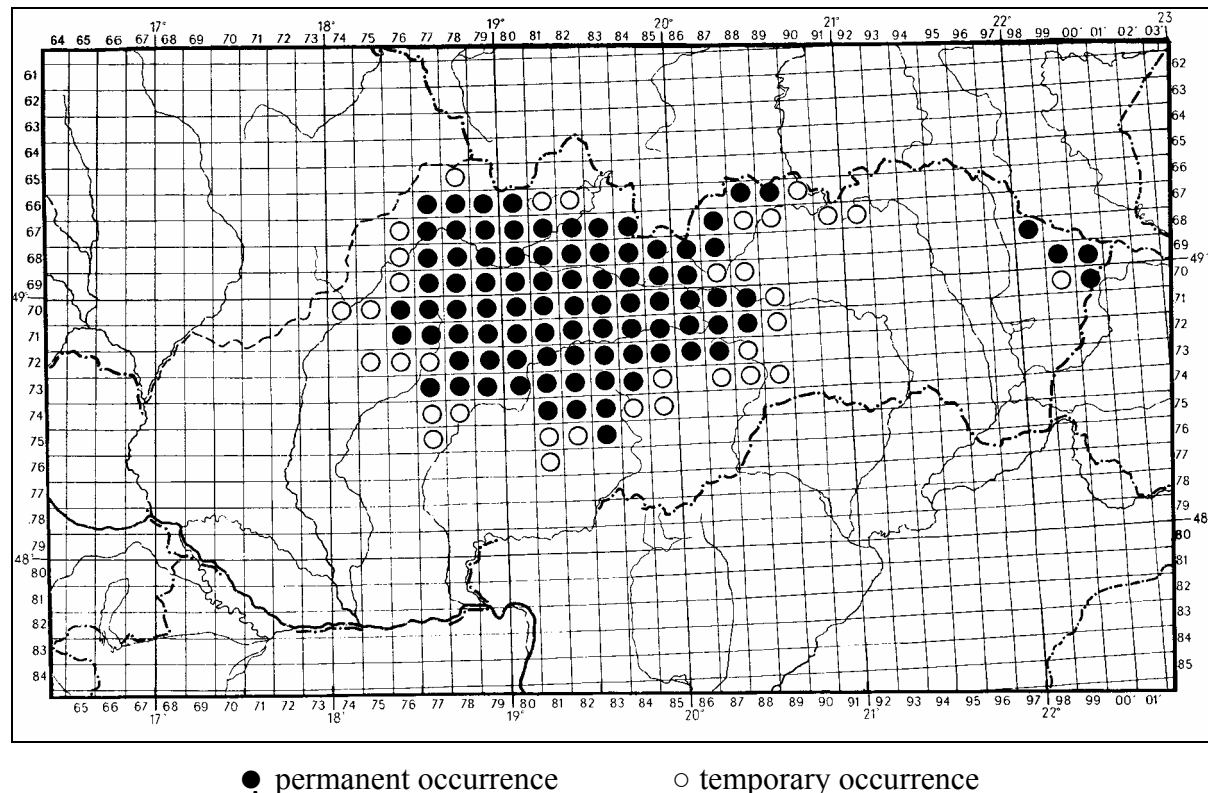
The expanding West Carpathian sub-population (in central Slovakia and southern Poland) is thought to have become reconnected to the East Carpathian sub-population (in northeastern Slovakia, southeastern Poland and southwestern Ukraine) during the 1970s (Martínková and Zahradníková 2003 citing Janík et al. 1986) or 1980s (Jakubiec 2001), when the total area of forests in which bears occurred in Slovakia was c.9,000 km² (Sabadoš and Šimiak 1981). According to Swenson et al. (2000), the range expansion that resulted in this reconnection occurred rapidly: c.200 km in less than 20 years. Presumably, the ranges of both sub-populations were expanding towards each other. Bear presence in the Slovak-Polish border region linking the 2 sub-populations may still be intermittent, possibly limited by poaching in eastern Slovakia (Hell and Slamečka 1999).

In the mid-1990s, the total range of permanent bear occurrence in Slovakia was estimated at c.10,000 km² (Hell and Sabadoš 1993, Janík 1997). Janík (1997) stated that there was approximately 8,000 km² of “*best habitat*”, 2,500 km² of “*peripheral mountain ranges*” and a further 2,000 km² used by bears “*on a temporary basis*”, particularly in autumn. An estimate for 1996 of 3,000 km² given

in the Council of Europe's *Action Plan for the Conservation of the Brown Bear in Europe* (Swenson et al. 2000) is clearly an error and presumably should have been 13,000 km², as stated in the *European Brown Bear Compendium* (Linnell et al.

2002b). Unfortunately the mistake has been reproduced elsewhere, including in the *Brown Bear Management Plan for Croatia* (Dečak et al. 2005) and a report by TRAFFIC on brown bear management and trade (Knapp 2006).

Fig. 1.2. Brown bear distribution in Slovakia in 2005. Source: State Nature Conservancy.



Currently, bears can be found in most of Slovakia's mountain ranges, especially in central and northern areas (Fig. 1.2). Distribution is closely linked to forest cover (Fig. 1.1). The most recent available estimates of range size are c.13,000 km² in the West and c.1,200 km² in the East Carpathian Mountains (Mind'áš et al. 2006). In Poland, there are bears in an additional c.3,000 km² of the West Carpathians and c.4,000 km² of the East Carpathians (Frackowiak et al. 1999, Frackowiak and Perzanowski 2002). Bears are known to have occurred in a total area of 3,360 km² in the Czech Republic since 1946, though only 540 km² have regular occurrence (Červený et al. 2006). In the

West Carpathians the total range of regular bear occurrence is therefore c.16,500 km².

Habitat in Slovakia is rather fragmented, resulting in a pattern of high bear densities in some mountain ranges, with much lower densities in lower lying areas between, where human activity is more intensive.

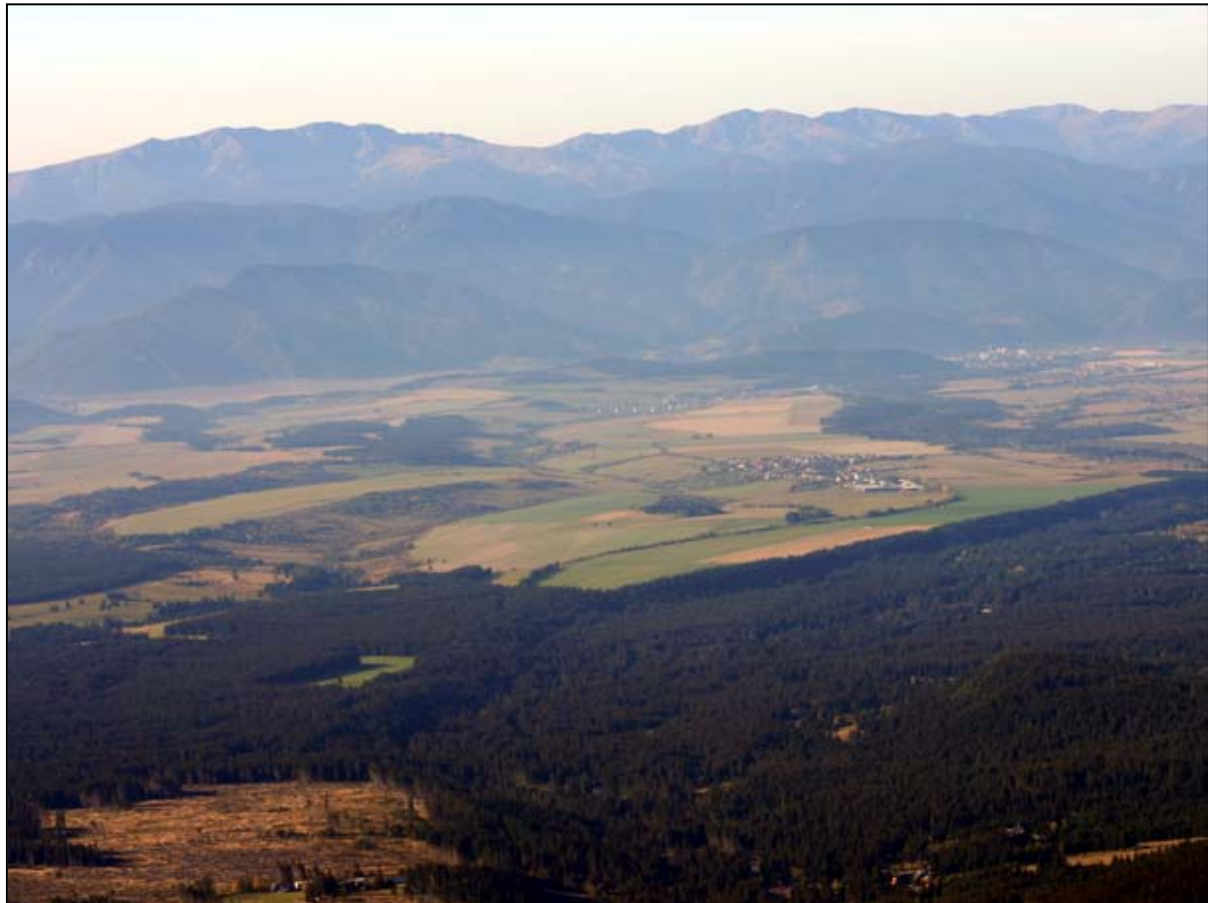
Although the Council of Europe's action plan (Swenson et al. 2000) stated that, "nearly all suitable habitat is occupied" and so, "no further increase in range and population size is expected", dispersing bears have continued to reoccupy additional areas, for example more frequent occurrences, including denning, have been recorded in Vihorlat and Laborecká vrchovina Mountains in eastern

Slovakia bordering Ukraine and Poland (Pčola 2003) and individuals have been tracked in the Slanské Mountains of eastern Slovakia (Fig. 1.1). There is ongoing dispersal westwards into Moravia in eastern Czech Republic (Červený et al. 2004a), southwestwards from Strážovské vrchy to Považský Inovec (Teren 1987a, M. Adamec pers. comm.), southwards beyond Zvolen and Banská Štiavnica (Hell 2003) and southwards towards the Hungarian border in the vicinities of Veľký Krtíš, Rimavská Sobota and Rožňava. Some authors (e.g. Hell 2003) consider the presence of bears in some of these areas to be undesirable for economic and human safety reasons. On the other hand, dispersing bears seem to have been

roaming less far in recent years than in the 1980-90s, which is apparent from a comparison between the map of recent distribution (Fig. 1.2) to that of confirmed bear occurrence since 1963 (Fig. 1.1).

There have been suggestions by Polish authors (Frackowiak and Perzanowski 2002, Jakubiec 2003) to reintroduce bears to additional mountain areas beyond the Carpathians, such as the Sudety, Krkonoše and Jizerské Mountains in Poland and the Czech Republic, in order to increase bear range in areas less densely populated by humans. Dispersing individuals reached some of these areas in 1980-99 but did not become established there (Červený et al. 2004a).

Habitat for large carnivores is rather fragmented in Slovakia, as forested mountain ranges tend to be separated by lower-lying, open areas which have higher levels of human settlement and activity. This is a view from the Tatranský National Park looking south across the largely deforested, agricultural region of Liptov, with the Nízke Tatry National Park in the background.



1.1.4. Numbers

Hell and Slamečka (1999 p.144) concluded in their monograph on the species that it is not known how many brown bears there are in Slovakia. The only range-wide population census is the Poľov 1-01 system of hunting statistics. Under this system, an estimate of the bear population size is derived by adding together the numbers of bears reported in each of the country's hunting grounds, of which there were 1,806 in 2005, together covering c.90% of Slovakia. It is widely acknowledged by both hunting and conservation managers that these figures are substantially overestimated due to multiple counting of the same individuals in more than one hunting ground. Staff of Zvolen Forestry Research Institute, who compiled the official statistics for the 2002-03 hunting season, commented that 700-800 bears was a “*realistic estimate*” (Lehocký et al. 2003b). The then director of the State Nature Conservancy (SNC) stated that, “*in reality the population does*

not exceed 700-750 individuals” (Kassa 2003). The total given in Poľov 1-01 hunting statistics for 2003 was 1,318 i.e. 65-88% higher than these expert estimates.

A track count conducted jointly by hunters, foresters, the SNC and activists of non-government organisations (NGOs) in Poľana Hunting Reserve (c.800 km²) in December 2001 recorded the presence of 90 bears, suggesting that the number given for the area in Poľov 1-01 statistics was 56% too high (after Lehocký 2002). Poľov 1-01 statistics gave the total number of bears in Slovakia as 1,350 in March 2001 and 1,211 in March 2002. Extrapolating the 56% error found in Poľana to the national level therefore produces an estimate of 779-868 bears in 2001-02, which is very similar to expert estimates. Similar figures are obtained by making the same comparison for Západné Tatry (Tab. 1.2). Bear numbers have been censused in other mountain ranges (e.g. in Malá Fatra every year since 2003) but so far complete analyses do not seem to be available.

Tab. 1.2. Comparison of official estimates (Poľov 1-01 hunting statistics) of bear numbers and census results in model (core, protected) areas based on mainly snow tracking (Poľana, Poloniny, Veľká Fatra) or direct observations (Malá Fatra, Západné Tatry). Density estimates for model areas are based on census results. Estimates of national population size are derived by calculating the difference between census results in model areas and official estimates in the years preceding and following the respective census and extrapolating to the national level. Compiled from data in Lehocký 2002, Pčola 2003 and information provided by E. Baláž, M. Kalaš, M. Králik, M. Majda, Ľ. Remeník.

Mountain range	Approx. study area (km ²)	Date of census	Estimated bear nos.		Difference between official and census	Density estimate (bears./100 km ²)	Extrapolated national population estimate
			official	census			
V. Fatra	650	11/1999		35-50		5-8	
Poloniny	400	2000		18		5	
Poľana	800	12/2001	140	90	+56%	11	779-868
M. Fatra ^a	450	5/2003		30-35		7-8	
Z. Tatry ^b	450	2003-04	53	31	+71%	7	771-829

^a Only the National Park core area and buffer zone were included; a high proportion of forest cover probably led to underestimation of numbers by the method used (visual observation), while double-counting was less likely compared to results from track counts. ^b Excluding hunting grounds used by TANAP State Forestry Service.

The data currently available (Tab. 1.2) suggest that around 800 individuals is a reasonable estimate for the total number of bears in Slovakia. This is likely to be c.6% of all European brown bears living in the wild outside Russia (data in Swenson et al. 2000).

Tab. 1.3. Comparison of expert estimates of bear numbers by mountain range in 1967 and 1999-2005 and the apparent average annual growth rates. Sources: Jerguš 1972, Jasík et al. 2003, Lenko 2005 and information provided by Ľ. Remeník.

Mountain range	No. of bears		Average annual growth (%)
	1967	1999-2005	
Nízke Tatry	85	100-150	0.5-1.6
Slovenské rudohorie	72		
Malá Fatra	58		
Veľká Fatra	41	35-50	-0.5-0.6
Vysoké Tatry	32	74	2.2
Kremnické vrchy	29		
other	17		
Total	334	800	2.4

Population estimates generally seem to encompass all individuals, including cubs. Jamnický (1987) is one of the few Slovak authors to have clearly distinguished between adults and cubs when estimating population density.

Despite a lack of precision in population estimates, there is no doubt that there are currently more bears in the West Carpathians than at any other time in the last 150 years or more (Hell 2003). An

interesting comparison can be made between recent estimates of numbers for individual mountain ranges and those made on the basis of den sites, direct observations and tracking by forestry employees in March 1967 (Tab. 1.3).

Genetic effective population size could be significantly smaller than the total population size. Despite it consisting of an estimated 700 bears in total, the effective population size of the southern-most population in Scandinavia has been estimated at less than 100 individuals. Due to low rates of immigration, loss of genetic variation and fitness because of inbreeding effects could become concerns for this population within decades (Tallmon et al. 2004). There is likely to be a low rate of immigration into the West Carpathian sub-population, as it is almost isolated.

In addition to individuals in Slovakia, the West Carpathian sub-population extends into southern Poland, where there are estimated to be c.20-30 bears (Jakubiec 2001, Hell 2003, Zięba and Kozica 2005) and eastern Czech Republic, where there are thought to be 2-5 bears (Bartošová 2001, 2003, Červený et al. 2004a), although probably many of these individuals have home ranges partially in Slovakia.

Moreover, the West Carpathian sub-population is regarded as no longer isolated but once more contiguous with that in the East Carpathians of northeast Slovakia, where there are perhaps 20-30 bears (Pčola 2003), southeast Poland, with an estimated 60-75 individuals (Jakubiec 2001, Zięba and Kozica 2005) and the Ukrainian Carpathians, with around 300 bears (Wasidlow in Rigg 2005b). It is very likely that some of these bears also have trans-border home ranges.

1.1.5. Density

If there are currently c.800 bears in Slovakia, as seems reasonable to suppose from the available data, in a total range of c.13,000 km², this is equivalent to a mean density of c.6 inds./100 km². There is certainly considerable geographical and seasonal variation. The highest densities are found in those regions of central Slovakia from which the population recovered (Fig. 1.3). In the mid-1990s, the “*best habitat*” was thought to support densities of 6-16 inds./100 km² and “*peripheral mountain ranges*” had perhaps 1-6 inds./100 km² (Janík 1997). The overall average density in occupied range in Poland may be only c.1 ind./100 km² (Frackowiak and Perzanowski 2002).

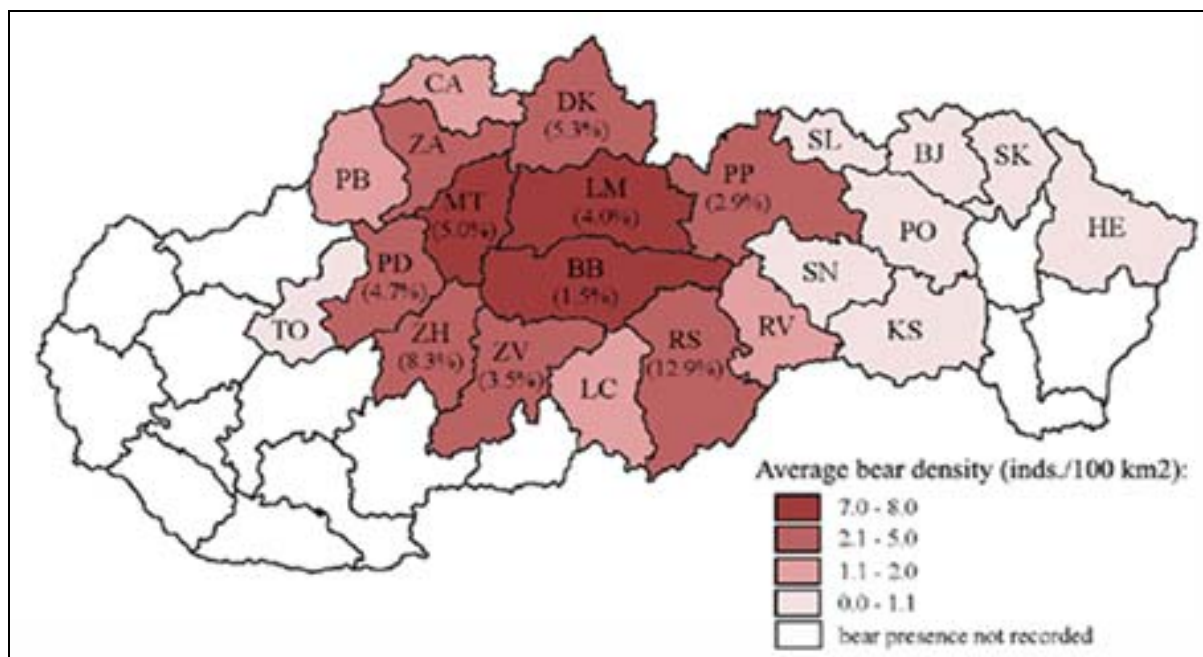
Density estimates derived from census results in model areas, each conducted during a period of < 1 year in the majority of the mountain range in question, are shown in Tab. 1.2. These censuses were done in protected areas with high quality habitat and relatively little disturbance.

They tend therefore to have the highest densities of bears, up to 11 inds./100 km². Densities are generally much lower in adjoining areas as well as in peripheral parts of the range, where there is less forest cover and more human activity.

Several bears may assemble to feed on seasonally abundant food such as berry patches, orchards, pre-harvest crops and game feeders. Such gatherings are not reflective of general density: telemetry research in Romania showed that bears travel up to 15 km or more to reach rich food sources (Mertens and Sandor 2000).

The number of bears using a strictly protected area of c.100 km² in Západné Tatry has been reported as 22 (Lenko 2006) and even 41-47 individuals (Baláž 2002, 2003). However, these total counts, based on cumulative visual observations and track counts from spring to autumn, in some cases made over several years, are not equivalent to estimates of average density: it is generally not known how many bears were present concurrently.

Fig. 1.3. Average bear density in Slovakia by administrative region. Calculated from data in Kaštier (2004) scaled to an estimated total number of 800 individuals in Slovakia. The figures in brackets are estimates of average annual growth rates from 1985 to 2000-02 (see Tab. 1.4).





The mixed forests of Poľana seem to harbour some of the highest densities of bears in Slovakia. There is intensive supplementary feeding of game by hunters in this area.

A commission dealing with bear hunting management in the 1960-70s considered 300-500 individuals in a 12,000 km² range to be a “tolerable number” and 350-400 the “optimal number” of bears in Slovakia (Šprocha in lit., Jerguš 1972, Dubovský in lit., Teren 1987a), equivalent to an average density of 2.5-4.2 inds./100 km². Hell (2003) considered 3-5 inds./100 km² to be the “optimal” bear density for Slovakia, but gave no explanation for how this figure was determined or to what type of habitats it applies and at what time of year. If the West Carpathian sub-population is considered as a whole, c.800 bears in a total range of c.16,500 km² is equivalent to an average of c.5 inds./100 km².

For comparison, estimates of the average population density in Romania range from c.8 to 25 bears/100 km² and according to some authors may exceed 30 bears/100 km² in the best habitats (Şelaru and Ionescu 2005, Anon 2005) and may

reach even 50 inds./100 km² if there is supplementary feeding (van Maanen et al. 2006). In Croatia, bear density is thought to vary from 5 inds./100 km² in zones of occasional bear presence to 15-20 inds./100 km² in the best quality habitats. The biological carrying capacity of the c.12,000 km² of bear habitat in Croatia is estimated at 1,100 individuals (Dečak et al. 2005).

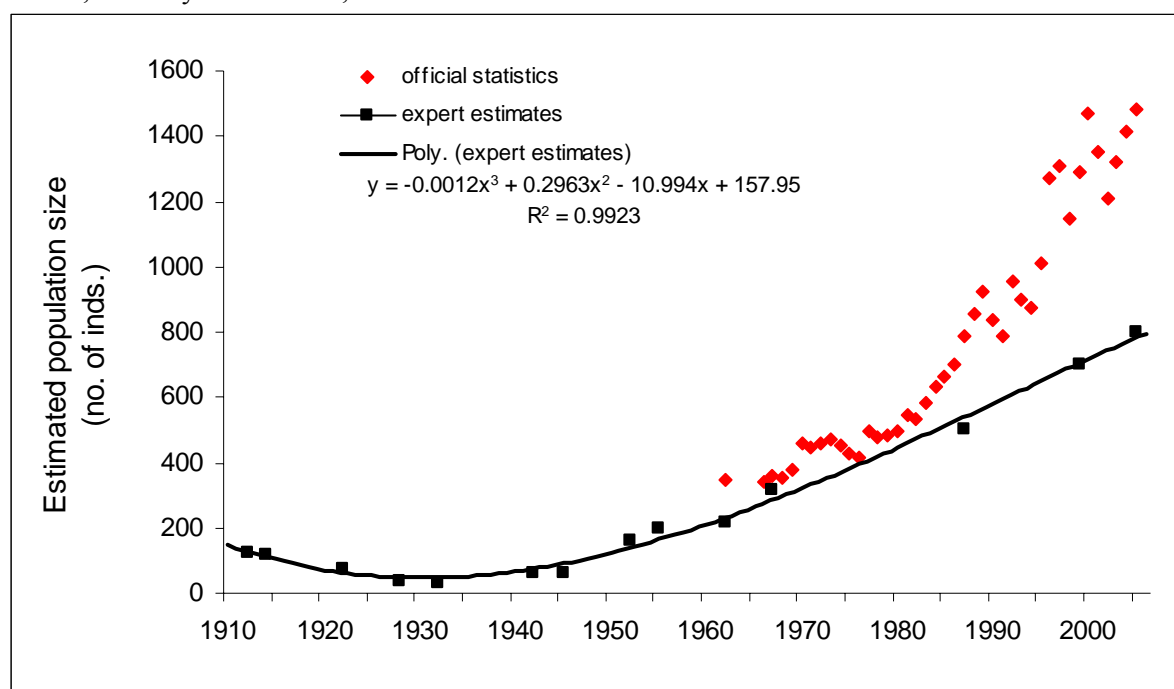
In general, bear population density is naturally lowest in northernmost regions of the world and increases southward. It is usually positively associated with food availability. Populations in productive deciduous and mixed forests of the Carpathian and Dinaric Mountains reach far higher densities than populations in northern coniferous forests (Swenson et al. 2000). Densities in core areas of the Slovak Carpathian Mountains are therefore high but not unusually or unexpectedly so for good quality habitat in central Europe.

1.1.6. Population trend

Almost all bears living in Slovakia derive from what in the 1930s was a small, isolated sub-population surviving in the central West Carpathian Mountains. Following a ban on hunting imposed in 1932/33, the remnant population expanded in both numbers and range. The trend of expert estimates of population size (Fig. 1.4) shows a typical pattern of growth as remaining habitat has become repopulated. Estimates of population size continued to increase despite the resumption of hunting in 1958-62.

A national system of estimating bear numbers based on observations by foresters was introduced in the 1960s. For the first 20 years or so of the system, these official estimates closely followed the trend-line of expert estimates (Fig. 1.4). Then, from the early 1980s, the official statistics began to differ more markedly from expert estimates. Official estimates of bear numbers increased most dramatically from c.800-950 bears in 1987-94 to c.1,150-1,577 bears in 1996-2006, with an increase of 50% in the two years from 1994 to 1996.

Fig. 1.4. The number of bears in Slovakia according to expert estimates (from 1912 to 2005) and official hunting statistics (from 1966 to 2006). Sources: Hell and Slamečka 1999 and references therein, Červený et al. 2004b, records held at the SNC.



It seems unlikely that a bear population would actually undergo such a large and rapid surge. Estimates of bear numbers in Poland stabilised or even declined from the mid-1980s to the mid-1990s (Jakubiec 2001). The long-term population trend in Slovakia during the period 1932-2005, calculated using natural logarithms of population size (cf. Swenson et al. 1994) as estimated by experts, appears to have been an average growth of c.4.5%/year, or doubling of the population every 15-16

years. (The rate would be lower if bear numbers in the 1930s, when the population reached a minimum, were not as low as estimates then suggested.) For comparison, the long-term growth rate of the hunted bear population in Romania has been estimated at 4.2% per year (Şelaru and Ionescu 2005). The rate of increase of the bear population in Sweden in 1943-91, where legal harvest was estimated to remove 5.5% of the population per year, was estimated at 1.5%/year (Swenson et al.

1994). Growth in 1998-2005 was 5.5%/year (J. Swenson pers. comm.).

The difference between official and expert estimates in Slovakia was estimated at 24% in the mid-1980s but now seems to have increased to 65-88%. This growing discrepancy might be a reflection of how hunters (foresters) have reacted to the gradual tightening of restrictions on hunting. Several marked changes in the trend of hunter-based estimates of bear numbers have corresponded to important events. Official statistics began to diverge more markedly from expert estimates shortly after the introduction of quotas by weight category. The new, higher rate of "growth" in hunting statistics continued until 1989, when a revolution led to the end of communism in Czechoslovakia, following which official estimates of bear numbers oscillated more widely between 800 and 950 individuals before the sudden massive "increase" of 50% in 1994-96. A new nature protection law was passed in 1994 that led to much stricter rules for bear hunting, perhaps motivating hunters to exaggerate bear numbers to justify their applications for hunting licenses. An additional factor could have been the restructuring of hunting grounds in the 1990s, leading to smaller but more numerous hunting grounds and thus increasing the potential for multiple counting of the same bears.

The Council of Europe's *Action Plan for the Conservation of the Brown Bear in Europe* (Swenson et al. 2000) states that, "the population in the four [Carpathian] countries has reached or passed its optimal number, and nearly all suitable habitat is occupied". In Liptov, part of the core area of bear distribution in Slovakia, hunters' estimates of numbers increased little if at all from 2000 to 2006 (data in Košecký et al. 2007). However, as Janík (1997) noted, the continued population growth observed in Slovakia as a whole suggests that the total biological carrying capacity has not yet been reached. It seems

reasonable to conclude from the available data that the bear sub-population in the West Carpathians (Slovakia, Poland, Czech Republic) continued to increase in numbers into the early 21st century and is still growing, mainly in peripheral areas.

If expert estimates are a more accurate indication of population size than official Poľov 1-01 hunting statistics (the available data suggest that they are), these findings are compatible with at least 3 possible conclusions: 1) hunting pressure has had little if any effect on population growth rate, which has been following a typical S-shaped curve as bears recolonised and filled up available habitat, the biological carrying capacity of which has not yet been reached; 2) without trophy hunting, the population would have reached its present size earlier; 3) trophy hunting from the 1960s to the 1980s in some way contributed to an increase in population growth rate.

The first of these scenarios could be possible if hunter harvest has been below maximum sustainable levels. From the 1960s to the 1980s the population was growing rapidly, so hunters could have harvested a relatively large proportion of bears without preventing the population from growing.

On the other hand, there is some evidence in support of the hypothesis that trophy hunting has limited the rate of population growth. The apparent average annual growth rate from 1985 to 2000-02 was lowest in Banská Bystrica, a region with the highest rate of harvest, and highest in Rimavská Sobota, an adjoining region with much lower hunting pressure (see Fig. 1.3 and Tab. 1.4), although this is probably also due to the habitat in Banská Bystrica being closer to saturation at the start of the period (harvest data in Hell and Sabadoš 1995, SNC records). Bear numbers in Poland, where there was no legal harvest, increased 8-fold during the period 1960-1985 (Jakubiec 2001), while during the same period numbers increased

by 2- or 3-fold in Slovakia (with regulated hunting) and declined in the Ukrainian Carpathians (heavy hunting pressure). This may also be partly explained by relative proximity to carrying capacity, or perhaps some bears chose to spend more time in Poland to escape hunting pressure in Slovakia and Ukraine.

Tab. 1.4 Comparison of estimates of bear numbers by administrative region in 1985 and 2000-02 (the latter using official Poľov 1-01 hunting statistics scaled to a total estimate of 800 individuals) with apparent average annual growth rates. Sources: Teren 1987a, Halák 1993, Kováč 2003, Kaštner 2004.

Admin. Region	No. of bears		Average annual growth (%)
	1985	2000-02	
BB	120	152	1.5
ZV	25	44	3.5
ZH	9	34	8.3
LM	80	151	4.0
MT, ZI	60	134	5.0
PD	18	38	4.7
DK	20	47	5.3
RS	6	47	12.9
PP/TANAP	19	30	2.9
other	143 ^a	123	-0.9
Total	500	800	2.9

^a Derived by subtracting estimates in Teren (1987a) for particular regions from an overall estimate of up to 500 individuals in Halák (1993).

The third possible scenario, that hunting increased population growth rate, is the most complex to assess. According to Hell et al. (2005), the rate of population growth in Slovakia began to slow in the mid- to late 1990s, which paradoxically is when hunting regulations became much more strict and hunter success rate declined.

Until recently, trophy hunting was heavily male-biased. There is evidence that males became scarce in some areas of

Slovakia in the period from the mid-1970s to the mid-1980s (Jamnický 1988a). Some authors (e.g. Janík 1987, Hell and Sabadoš 1993) believe that a prevalence of females and young bears caused by male-biased trophy hunting resulted in “excessive” population growth. According to this hypothesis, reduced sexual and territorial competition due to the selective removal of dominant males might have led to population density reaching artificially high levels. This hypothesis has never been tested using data from Slovakia, but there are precedents in the literature. It is well established that male brown bears kill cubs and other individuals (McLellan 2005), so removing them might result in population increase.

Kemp (1974) found that removal of older male black bears (*Ursus americanus*) in Alberta, Canada, resulted in local population increases, mainly due to immigration of young males. However, studies of the Scandinavian brown bear population found decreased survivorship of cubs following selective removal of adult males, which it was suggested was due to sexually selected infanticide (Swenson et al. 1997a, 2001a,b). Miller et al. (2003) found that in heavily hunted populations of brown bears in Alaska, cub survivorship was higher and litter sizes were larger or unchanged compared to nearby un hunted populations thought to be near carrying capacity. These authors concluded that density-dependent effects influenced cub survivorship only in populations near carrying capacity. McLellan (2005) concluded that, if sexually selected infanticide operates in brown bears, its level of expression can be expected to be influenced by other factors, including searching efficiency for mates and population sex ratio.

Reducing the ratio of males in the population could be expected to decrease the prevalence of sexually selected infanticide and hence increase cub survival (McLellan 2005), but if the sex ratio is

already < 40% males then removing more males may not affect recruitment (Miller et al. 2003). On the other hand, killing her cubs to bring a female into oestrus could be more profitable to males at lower population density. In general, hunted populations have greater recruitment rates than unhunted populations at carrying capacity (McLellan 2005).

Intraspecific killing that is not sexually selected is relatively common in brown bears. Cannibalism by bears in Slovakia was known during the 1960s (Halák 1993)

and has also been recently documented (Fig. 1.10). Presumably it would tend to become more common as population density increases.

Clearly, population dynamics and their relationships to population density, sex ratio, habitat carrying capacity, predatory and social behaviour are complex phenomena which are currently occupying some of the world's leading bear researchers. The paucity of data and deficiency of robust studies from Slovakia do not permit many firm conclusions.



1.1.7. Age-sex structure

Although data on fertility and age-sex structure are regarded as being critical for successful management (Danilov 1994), they are somewhat lacking in Slovakia, where the only reasonably robust attempt to evaluate the structure of the bear population was conducted 15 years ago. It has been widely supposed that the age-sex structure of the West Carpathian sub-population was markedly disrupted by male-biased trophy hunting from the 1960s to the 1980s (Janík 1987, Hell and Sabadoš 1993, Kassa 2003). Trophy hunting caused a similar situation in Romania, but there it is believed that by banning the hunting of bears >180 kg for 10-15 years the population can be restored to a natural age-sex structure (Şelaru and Ionescu 2005). In Slovakia, the harvesting of bears >150 kg has been restricted for the last 25 years and banned for c.15 years, although this rule is regularly broken (see 3.5.2).

Two wide-ranging studies of Slovakia's bear population structure have been published. The methodology for the first of these was not clearly described, but was partially based on direct observations at 55 feeding sites in 1977 (Sabadoš and Šimiak 1981). According to questionnaires completed by state foresters, involved in implementing bear hunting management, of 391 observed bears believed to be permanently settled within foresters' areas of jurisdiction, 35% were "young", 31% were females, 16% "large old males" and 18% other males. No indication is given in the study of how the sex and age of free-living bears were determined.

The second and more robust analysis was conducted in 1992 and published by Hell and Sabadoš in 1995. On the basis of track counts ($n=362$) and direct observations ($n=547$) by forestry personnel, in comparison with regression plots of front paw width to body weight and age (Hell and Sládek 1994), the authors concluded that 20% of the population was composed of bears at least

12 years old but less than 5% were the oldest males (front paw width at least 18 cm). Estimates of the proportion of cubs of the year in the population obtained by visual observation and by tracking were very similar: 17.6% and 16.6% respectively. Although the authors of this study seemed to consider these figures to be high, they are lower than published estimates for northwest Russia (Danilov 1994): the Karelian bear population was found to contain on average 23.5% cubs of the year and 12.6% yearlings, while in two other regions the respective figures were 18.2-18.7% and 9.1-11.9%. (Litter size is discussed in sections 1.1.8 and 2.6.)

In addition to these published studies, SNC records include more recent observations of age-sex classes seen at feeding sites and reported by foresters/hunters. A partial analysis of data from 2003-04 is included in Table 1.5.

There is probably local variation within Slovakia. More large males have been observed in areas with very little hunting and low human disturbance in comparison to an area of greater disturbance and regular hunting (Tabs. 1.5 and 1.6), although conclusions are weak because sample sizes were small, methodologies not standardised and other important habitat variables besides level of human activity differed among the study areas.

On the basis of Scandinavian bear population data, Swenson et al. (2000) predicted that there would be few females in recently colonised areas such as the contact zone between the West and East Carpathians. Maps of bear distribution based on presence/absence data (e.g. Fig. 1.2) usually show a substantial gap with no bear occurrence between the West and East Carpathian sub-populations. More permanent presence of bears, including females with cubs, has been observed in parts of this area in recent years (K. Soós pers. comm.) and there is believed to be greater connectivity on the Polish side of the border (Jakubiec 2001).

Tab. 1.5. Social structure of some local communities of bears in comparison to a range-wide census as estimated by direct observations (censuses, Západné Tatry) or tracking in snow (Poľana, Poloniny). Sources: compiled from data in Hell and Sabadoš 1995 (range-wide census 1992), Baláž 2002, 2003 (Západné Tatry 1994-2001, Poľana 2001), Pčola 2003 (Poloniny 2000-01), SNC records (partial census 2003-04), M. Králik pers. comm. (Západné Tatry 2004), R. Rigg pers. obs. (Poľana 2007).

	Cubs / yearlings		Females w/cubs		Males	Other or unclassified	n
	<1 yr	1-2.5 yr	<1 yr	1-2.5 yr			
Poľana (2001)	49%		16-19%		8%	24-27%	37
Poľana (2007)	33%		17%		11%	39%	18
Poloniny (2000-01)	17%	17%	11%	11%	11%	33%	18
Z.Tatry (1994-2001)	32-37%	9-20%	13-15%	4-5%	15-17%	15-22%	41-47
Z.Tatry (2004)	31%		12%		19%	38%	58
range-wide census (1992)	17.6%	^a	10.4%	^b	^a	^a	547
partial census (2003-04)	20.1%	^a	all females: 25.6%		22.4%	31.8%	308

^a Cannot be determined from the data available. ^b 12.6% of the population excluding cubs of the year.

Tab. 1.6. Size, age and sex structure of some local communities of bears in comparison to a range-wide census. Estimates based on direct observations (Západné Tatry) or measurement of front paw track width and comparison with regression plots by Hell and Sládek (1994) of track size to age and body weight (range-wide census, Poľana, Poloniny). Sources: compiled from data in Hell and Sabadoš 1995 (range-wide census 1992), Baláž 2002, 2003 (Západné Tatry 1994-2001, Poľana 2001), Pčola 2003 (Poloniny 2000-01), R. Rigg pers. obs. (Poľana 2007).

	Cubs, yearlings and subadults		Subadults and adults	Large adults			Unclassified	n
weight (kg): ^a	≤ 110		110-169	≥ 170	≥ 170			
track width (cm):	≤ 9.0	9.1-12.0	12.1-15.0	15.1-18.0	≥ 18.1			
age (years):	<1	1-2.5	2.5-11	≥ 12	≥ 12			
sex:	F & M	F & M	F & M	F	M	M		
Poľana (2001)	49%		35%	0%	8%	8%		37
Poľana (2007)	50%		44%	0%	6%	0%	-	18
Poloniny (2000-01)	17%	17%	39%	0-17%	0-17%	11%	-	18
Západné Tatry (1994-2001)	32-37%	9-20%	23-32%	9-10%		15-17% ^b	-	41-47
range-wide census (1992)	16.6%	25.1%	38.1%	15.5%	4.7%		-	362

^a Correlations of weight, age and track size are only approximate and decrease with age as sexual dimorphism becomes more pronounced. Values used in the table are based on measurements and observations in Hell and Sládek (1994) and Danilov (1994). ^b All estimated (by visual observation) to be between 200 and 350 kg.

1.1.8. Recruitment and mortality

Recruitment

Since the 1980s, the annual increment to the population has been considered by managers to be 10% of the total base stock (all bears >1 year old). For comparison, in Croatia (Dečak et al. 2005) and Romania (Anon 2005), the annual increment is thought to be 10-15%. Theoretically, a 25% increment before mortality is possible if sexually mature individuals comprise 50% of total base stock, the sex ratio is 1:1 and females have an average of 2 cubs each every second year.

The values of several key parameters are insufficiently known for the population in Slovakia, but a very crude estimate of annual increment can be made using data from the population census in 1992 (Hell and Sabadoš 1995). Assuming that there are currently 800 individuals in Slovakia including cubs, the total base stock might be $800 - 141 \text{ cubs (17.6\%)} = 659 \text{ bears}$. Of these, 12.6% are females with cubs of the year. Therefore annually 83 females have an average of 1.7 cubs each (i.e. a total of 141 cubs). If 25-50% of cubs die before 1 year of age, the annual increment to the population could be c.11-16%. This should only be considered an approximate guide, because litter size and the proportion of females with cubs in the population were assessed in only one year, 15 years ago, while mortality rates are not well known.

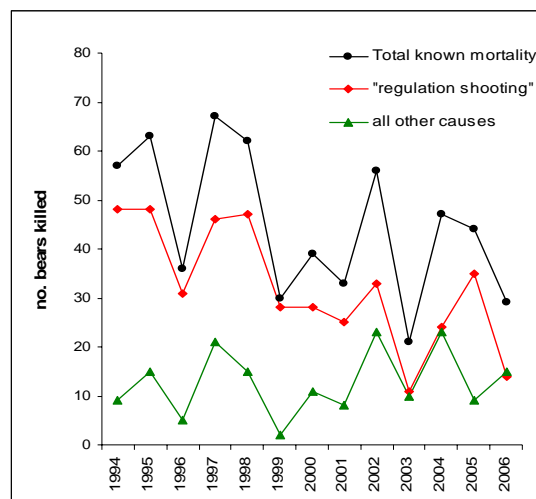
The actual long-term growth rate of the bear population in Slovakia (see 1.1.6) seems to have averaged c.4.5%/year since the population low in 1932. This figure reflects the difference between annual increment (reproduction) and all mortality.

Total known mortality

Total known mortality in 1994-2006 averaged 45 bears per year, equivalent to c.6% of the population (Tab. 1.7, Fig. 1.6), with peaks in May and October (Figs. 1.7, 1.8, 1.10, 1.11). This suggests that a quota of 10% for total known mortality, even if

filled, would not cause population decline. About 90% of known mortality during this period was human-caused. The trend was downward, due to a reduction in hunter harvest (Fig. 1.5). Cause of death was not identified in 8% of cases.

Fig. 1.5. Bear mortality by hunter harvest ("regulation shooting") and all other causes from 1994 to 2006. Sources as for Tab. 1.7.



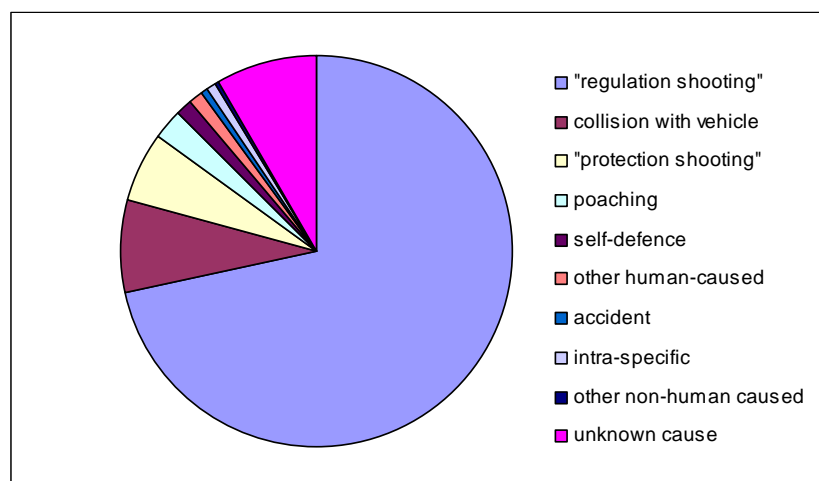
Natural mortality

Very few bears are found dead from natural causes. According to Hell and Sabadoš (1993), only 15 bears were known to have died from causes other than hunting in 1968-89, which is an average of 1 every 1.5 years or just 2.3% of the hunting bag during the same period. In recent years, 0-3 deaths per year (mean = 0.8, 1.7% of known mortality) have been attributed to natural causes and 1-7 (mean = 3.7) to unknown causes (Tab. 1.7). This is equivalent to a total loss to the population of c.0.5%/year. Natural deaths constituted 31% of known mortality from 1952 to 1999 in Poland, where there was no regular harvest (Jakubiec 2001). It is certain that many natural deaths, especially those of cubs, are not discovered. On the basis of anecdotal evidence, it has been suggested that mortality in the first year of life of cubs in the Tatras region might be 40-50% (Jakubiec 2001, Baláž 2002).

Tab. 1.7. Causes of known bear mortality in Slovakia from 1994 to 2006. Sources: compiled from records held at the SNC, Kassa 1995, 1996, 1998b, 2000a, 2001a, 2002a, 2003, 2006.

Year	Human-caused							Non-human caused				Unknown cause	Total known mortality
	"Regulation shooting"	"Protection shooting"	Self-defence	Poaching	Vehicle collision	Other	Sub-total	Intra-specific	Accident	Other / unknown	Sub-total		
1994	48	2					50					7	57
1995	48	5			2	2 ^a	57					6	63
1996	31		1	1			33					3	36
1997	46		2	3	8	2	61					6	67
1998	47	3+1 ^b	1		4	1	57		2		2	3	62
1999	28	1					29					1	30
2000	28	2	1	1	2		34					5	39
2001	25	1 ^b		4	2		32					1	33
2002	33	6			9		48	1		2	3	5	56
2003	11	2		2	2		17	1			1	3	21
2004	24	9	2	1 ^c	8	1	45			1	1	1	47
2005	35				3	1	39		1		1	4	44
2006	14	2	1	2	5		24	2			2	3	29
Total	418	34	8	14	45	7	526	4	3	3	10	48	584
Mean	32.2	2.6	0.6	1.1	3.5	0.5	40.5	0.3	0.2	0.2	0.8	3.7	44.9
% mortality	71.6	5.8	1.4	2.4	7.7	1.2	90.1	0.7	0.5	0.5	1.7	8.2	

^a 2 abandoned cubs found alive. ^b Captured alive. ^c Found alive with gunshot wound and was destroyed.

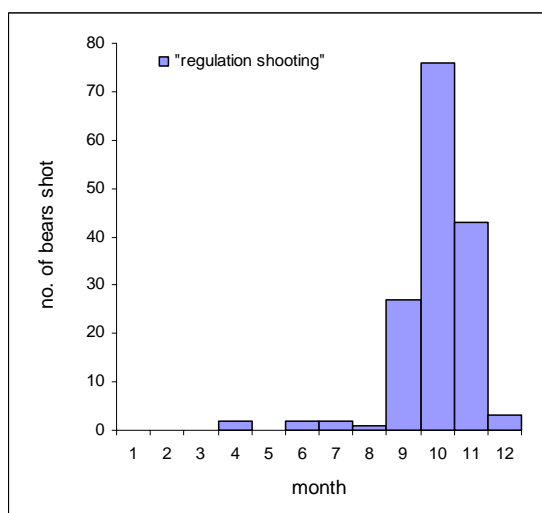
Fig. 1.6. Causes of known bear mortality in Slovakia from 1994 to 2006. Sources as for Tab. 1.7.

Hunter harvest

Over 1,300 bears have been shot since resumption of hunting in 1958-62. (See 3.5 for a description of hunting management.) Despite a decline in the number of bears shot since a peak in 1991-92, legal hunting continues to be the largest cause of known mortality. In the 13 years from 1994 to 2006, a total of 418 bears were killed by “*regulation shooting*” (range 11-48/year), which was 72% of all known bear mortality. This is equivalent to about 4%/year of the total estimated population (Tab. 1.7). A crude estimate of the sustainable legal harvest rate would therefore be $4 + 4.5 = 8.5\%$ /year, currently equivalent to c.70 bears. For comparison, maximum sustainable yield was estimated as c.7%/year for the Scandinavian bear population (Swenson et al. 1994).

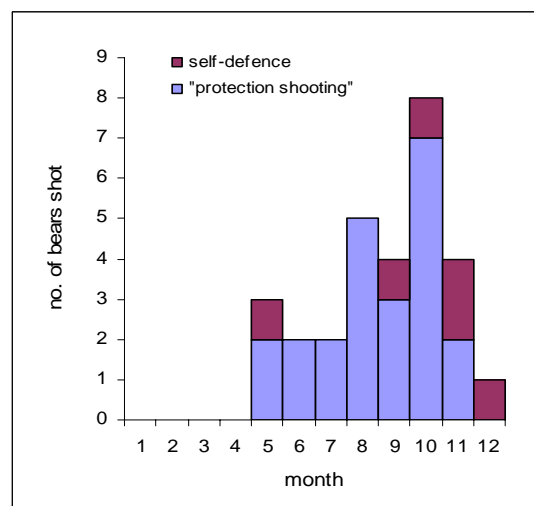
Violations of the legal hunting system appear to have been common. Indeed, the gradual tightening of restrictions on hunting seems to have been partially a reaction to frequent abuses. Rules continue to be infringed, most frequently when bigger bears are shot than had been permitted. According to data held at the SNC, 7 of 35 bears (20%) shot in 2005 did not meet size specifications.

Fig. 1.7. Monthly distribution of bear mortality by “*regulation shooting*” in 2000-05. Compiled from records held at the SNC.



In some years, bears are killed (usually shot) by hunters in self-defence during encounters. Such situations appear to be less common now than in the past: 8 bears (4 females, 1 male, 3 with no record of sex) were killed in self-defence in the 12 years from 1994 to 2006 (data held at the SNC) whereas 8 bears (3 females, 5 males) were killed in just 3 years, from 1985 to 87 (data in Hell and Slamečka 1999). Most of the recent cases happened in September-December (Fig. 1.8), which corresponds to when most bears are killed by “*regulation shooting*” (Fig. 1.7). During this period, bears are preparing to enter their winter dens or are already in them. It is one of the most active times of the year for hunters. Major game species harvested within bear range at this time include red deer *Cervus elaphus* (1.9. to 31.12.) and wild boar *Sus scrofa* (16.7. to 31.12.), the latter often hunted by groups of hunters working with beaters and dogs. All 7 incidents of self-defence shooting in 1990-2006 for which a record of the date was available occurred during weekends. Female bears, mostly ≥ 15 years old, were involved in $> 80\%$ of cases.

Fig. 1.8. Monthly distribution of bear mortality due to “*protection shooting*” (removal of problem individuals) in 1998-2005 and self-defence shooting in 1997-2006. Compiled from records held at the SNC.



Hunters also shoot a small number of bears unintentionally. According to data held by the SNC, 1 bear was mistakenly shot during a hunt for wild boar in 1997 and 1 in 2005. Other such cases are mentioned in the literature (e.g. Hell and Slamečka 1999, Baláž 2003, Karč 2007).

Poaching

Although poaching is usually thought to have increased since the 1989 revolution and consequent relaxation of state control, it was mentioned as a problem in the early 1980s (Kadlečík 1983) and was known to occur in the 1960s (see Martínková and Zahradníková 2003), before the current system of strict regulations was adopted. In fact, Šprocha (1977) referred to the poaching of bears at the beginning of the 20th century, when bear conservation did not exist, and Jerguš (1972) alleged that it continued even when the bear population was in critical danger of extinction.

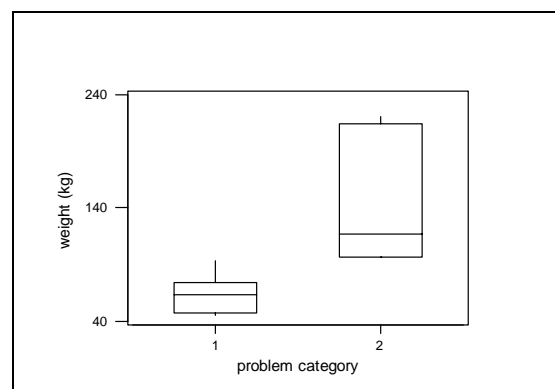
According to data held by the SNC, 14 cases of poaching were identified in 1994-2006, most of them in August-October (Fig. 1.10). Presumably known cases represent only a small proportion of illegal killing.

Linnell et al. (2002b) asserted that there is little evidence for such killing being motivated by the economic incentive from bear gall-bladders or other body parts which is becoming increasingly common in Asia and North America (Servheen 1999). This is somewhat contradicted by a proposal to up-list all brown bear populations to CITES Appendix I, which was tabled at the 10th Conference of the Parties in 1997 and included the statements that, *“Evidence has been presented of an established, and growing illegal trade in bear parts throughout the range countries of Europe, Eurasia and northern Asia. These continents are increasingly cited as the original source of bear parts in the illegal trade”* and, *“In the Slovak Republic ... whole cadavers of bears have been found with their skin removed.”*

Removal of “problem” bears

Less than 0.5%/year of bears are shot or otherwise removed as problem bears, most often in August-October (Fig. 1.8), accounting for slightly less than 6% of known mortality (Tab. 1.7). There seems to be a tendency for bears removed as problem individuals to be small/young (Fig. 1.13). Of 12 problem bears for which an estimate of age was available, 9 (75%) were aged 2-5 years (mean = 4.8, range 2-12). Although numbers of bears by weight categories killed by “*protection shooting*” in 1998-2004 are not significantly different from the general population as estimated by Hell and Sabadoš (1995) if they are all pooled together ($\chi^2 = 4.889$, d.f. = 2, $p = 0.087$), shot or captured human food-conditioned bears for which data were available were all <100 kg (mean = 63.3 kg, range 45-93 kg, $n = 6$) whereas the mean weight of shot bears alleged to have caused damage to beehives or livestock was 148.4 kg (range 97-221 kg, $n = 7$), a significant difference (Mann-Whitney U -test, $p = 0.0034$). See Fig. 1.9.

Fig. 1.9. Weights of “problem” bears shot in 1998-2004: (1) feeding on refuse; (2) causing damage to livestock/beehives. Source: SNC.



No significant difference was found between sexes: 12 males and 12 females (plus 16 unsexed bears) were shot as problem individuals in 1998-2004. The male:female ratio of bears shot after feeding on refuse was 3:3 and causing damage to livestock or beehives was 4:3.

Fig. 1.10. Monthly distribution of known bear mortality in 1997-2005 due to causes other than legal hunting, self-defence and vehicle collision. Compiled from records held at the SNC.

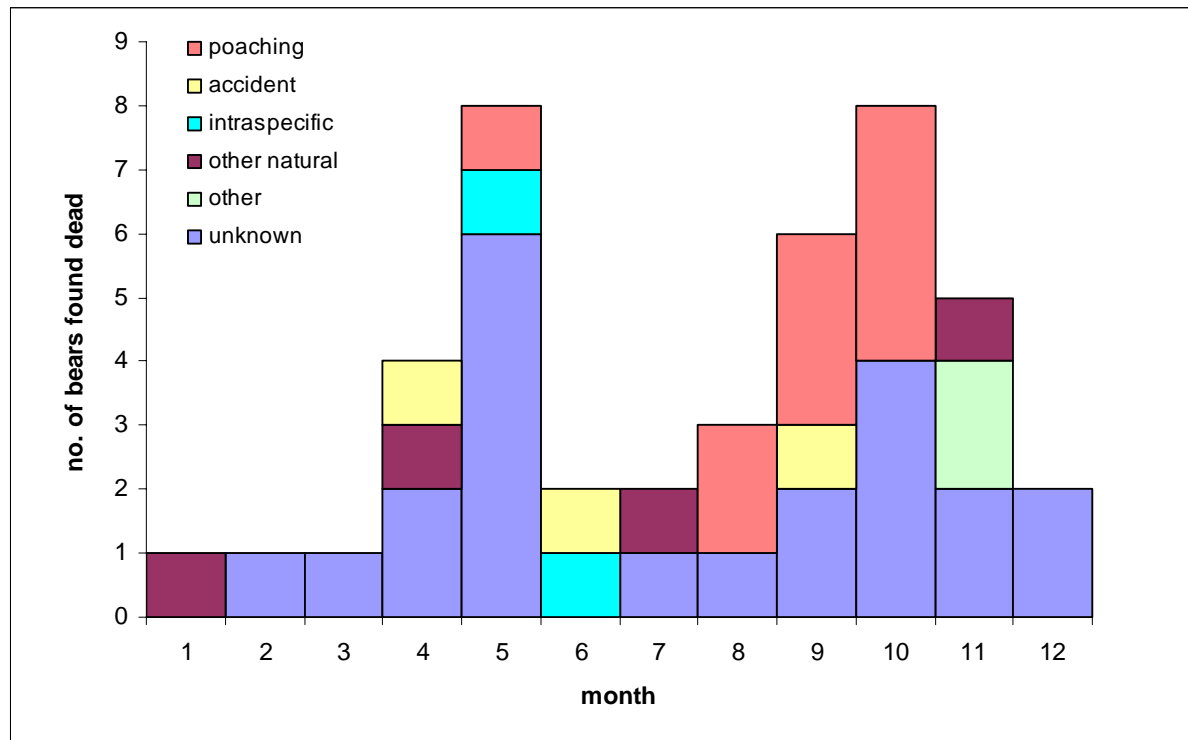


Fig. 1.11. Monthly distribution of bear mortality due to vehicle collision in 1997-2005. Compiled from records held at the SNC.

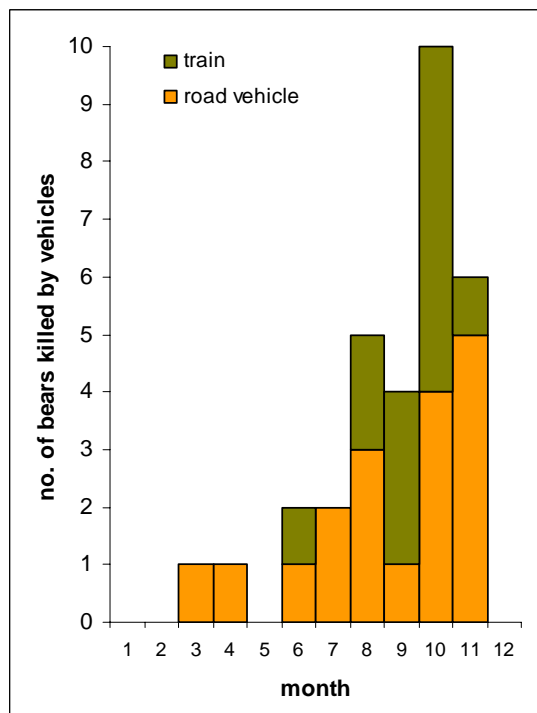
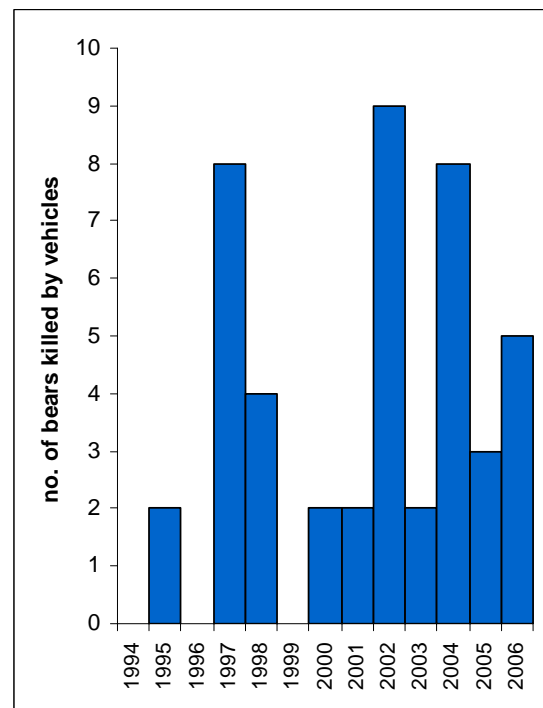


Fig. 1.12. Yearly distribution of bear mortality due to vehicle collision in 1994-2006. Compiled from SNC records, Kassa (2006).



Collisions with vehicles

An average of 3.5 bears per year are known to have been killed in 1994-2006 in collisions with vehicles, c.30% of them involving trains and c.70% road vehicles. More than three-quarters of the accidents occurred in August-November, with a peak in October (Fig. 1.11). Some involved bears crossing transport routes to reach fields of pre-harvest crops or other food (M. Adamec pers. comm.). There is an upward trend in the number of bears killed per year (Fig. 1.12). If adequate mitigation measures are not taken, deaths of animals on roads are likely to increase in the coming years as Slovakia's road network is enlarged and traffic volume increases.

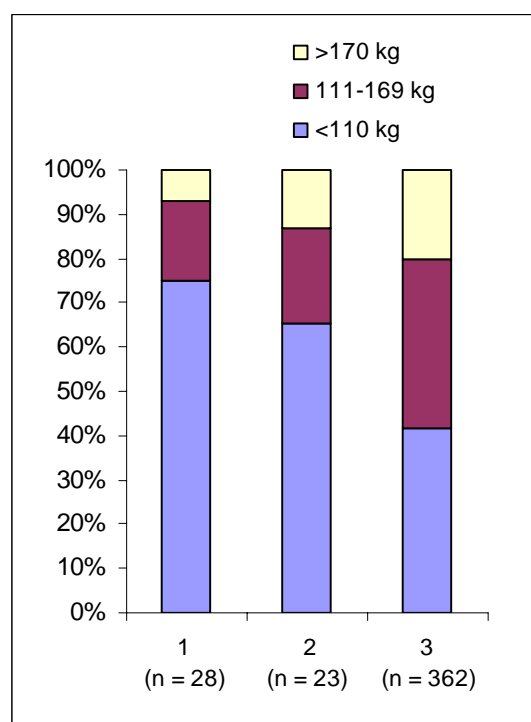
As shown in Fig. 1.13, 75% of all bears killed by vehicles weighed up to 110 kg, a significantly higher proportion than would be expected by chance based on the structure of the population as estimated by Hell and Sabadoš (1995) in 1992 ($\chi^2 = 11.732$, d.f. = 2, $p = 0.003$). No difference was found between the sexes: 14 males and 12 females were killed in 1997-2005. Of 14 individuals killed by vehicles and for which an estimate of age was available, 57% were up to 3 years old, 6/8 of them cubs in their first year of life. This is more than twice the proportion of cubs estimated in the population, suggesting that they are particularly susceptible to being hit by vehicles. One cub was killed by a train along with its mother during this period, on 30.10.1998. It is important to note that there were similar incidents in the past. In 1981-85, 5 bears were killed by trains on the 4-kilometre Stratená-Dedinky section of railway in Slovenský ráj NP (then PLA), including a female and her 2 cubs of the year on 12.10.1985 (Hájek 1987).

In Croatia, 46 of 73 bears (63%) known to have been killed by vehicles in 1963-94 were subadults (up to 3 years old). At least 33% of accident sites could be related to the presence of bear attractants such as roadside refuse. More than half the bears killed on roads in Croatia in 2000-02 were

young males and three-quarters of those killed by trains were young males or females (Huber et al. 1998, Dečák et al. 2005). Bears involved in traffic accidents in Slovenia have tended to be young males (Adamič 1997, Jerina 2005).

In Slovakia, wild animals are considered to be state property, but game in effect belongs to the user of the hunting ground in which it is found. Animals killed by vehicles should therefore be returned to the hunting ground user; their removal by other, unauthorised persons would be considered poaching. Nevertheless, there is no burden of responsibility on the hunting ground user to compensate for damage caused to a vehicle in collision with a game animal. Nor is the driver of the vehicle liable to pay compensation for the animal, which is usually considered to have "caused" the accident (Podlesný 2006, Kovács 2006).

Fig. 1.13. Proportions of bears by weight category: (1) killed by vehicles in 1997-2005; (2) shot as problem individuals in 1998-2004; (3) estimated in the general population in 1992. Compiled from records held at the SNC, Hell and Sabadoš 1995 (see Tab. 1.6).



Other human-caused mortality

A bear found dead by tourists on 7.11.2004 was discovered to have died as a result of its stomach being blocked by a large amount of plastic. The bear was a large male, its age estimated as 17 years. It weighed 240 kg when found but had probably been much heavier in life: its fat reserves had been depleted over a period of c.4-6 weeks during which it had probably not been able to feed (Kacerová 2005). Its skull set a new Slovak trophy record. There has been a similar case in Romania (G. Predoiu pers. comm.).

Undiscovered mortality

It has been observed that 17.6% of the population is composed of cubs of the year, i.e. the total base stock of bears over 1 year old increases by 21.4% with the birth of cubs (Hell and Sabadoš 1995). Using an estimated total population size of 800 bears including cubs of the year, the total known mortality in recent years has been 5.6%/year of the population, which is equivalent to 6.8%/year of total base stock. If known mortality represented all bear deaths, the population would be expected to grow at a rate of 14.6%/year (Tab. 1.8). However, the average growth rate observed since the 1930s has been only 4.5%/year. Therefore there must be additional, undiscovered or unreported, losses equivalent to 10.1% of total base stock, i.e. 66 bears per year.

Tab. 1.8. Discrepancy between expected and observed growth based on a total current population of 800 bears including cubs of the year and estimated according to the population structure described by Hell and Sabadoš (1995), known mortality in SNC records and an average observed growth rate of 4.5%/year.

	Bears	
	<i>n</i>	% ^a
Total base stock	659	-
Cubs of the year	141	21.4
Known mortality	45	6.8
Expected growth	96	14.6
Observed growth	30	4.5
Expected – observed growth	66	10.1

^a Percentage of total base stock.

This is a very crude calculation, but it indicates the order of magnitude of undiscovered mortality. Presumably a large proportion of the difference between observed and expected growth is due to the deaths of young cubs, but some could have other causes such as poaching. The actual figure may be somewhat higher than 66 bears, because some young cubs probably die before the female leaves the den and some cubs may have been missed by observers involved in estimating the population structure (Hell and Sabadoš 1995).





Highway construction threatens to increase habitat fragmentation by disrupting animal movement corridors. The environmental impact assessment for the section of the D1 (E50) shown above did not adequately consider impacts on large mammal movements between the Tatranský National Park (visible in the background) and Nízke Tatry National Park (to the left of the photograph).



Bear-human conflicts still tend to be resolved by shooting or capturing bears. Preventive measures, such as this bear-proof bin successfully tested by the Slovak Wildlife Society in 2007, could provide an alternative that would reduce damage as well as the need to remove bears from the population.

1.2. Legislative

1.2.1. International

CITES

All European brown bear populations are listed in Annex II (potentially endangered species) of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Annex II includes all species not in actual danger of extinction, but potentially endangered if trade is not strictly controlled. Special permission is required for export and import, including of trophies.

CITES has been in effect in Slovakia since 28.5.1992. According to CITES trade data, Slovakia exported 27 trophy items (range 0-6/year) during the period 1993-2003: 17 to EU-15 Member States, 9 to the Czech Republic and 1 to Switzerland (Knapp 2006).

In May 1998 the Scientific Review Group (SRG) of the European Union (EU), satisfied that the population of bears in Slovakia was expected to continue growing and then stabilise within a few years, gave a Positive Opinion allowing import of trophies to the EU. The Positive Opinion was automatically removed when Slovakia became part of the EU in May 2004.

The legal basis for the implementation of CITES within the European Union is European Community Regulation no. 338/97 on the protection of species of wild fauna and flora by regulating trade. The brown bear is listed in Annex A: threatened, extinct and rare species, trade in which would endanger their survival.

Bern Convention

Slovakia signed the Bern Convention on the Conservation of European Wildlife and Natural Habitats in 1994 and ratified it in 1996 (Council of Europe 2002) with effect from 1.1.1997. The goal of the Bern Convention is to preserve wild living animal species and their natural habitats.

Signatory states must pay special attention to endangered and potentially endangered species. The European brown bear is listed in Annex II (strictly protected fauna species). Useful and necessary actions have to be taken to enhance the special protection of species listed in Annex II; every form of capture, keeping or killing, wilful disturbance and possession or trade with these species is forbidden. Disseminating information on the necessity to preserve wild animal species and their habitats must be promoted.

Article 22 of the Convention permits any state to make one or more reservations concerning certain species specified in Appendices I to III in regard to certain means or methods of killing, capture or other exploitation. Such a reservation for the brown bear was made by Slovakia at the time of signing. Several other states have made reservations for the brown bear, including the Czech Republic and Ukraine. Slovakia's reservation states that, *"...the present level of their population in the Slovak Republic permits the regulation of their numbers without detriment to their survival and to the functions of these species in the natural ecosystems"* (Council of Europe 2002).

The Standing Committee of the Bern Convention has adopted several recommendations concerning bears:-

- No. 10 (1988) on the protection of the brown bear (*Ursus arctos*) in Europe.
- No. 43 (1995) on the conservation of threatened mammals in Europe.
- No. 59 (1997) on the drafting and implementation of action plans of wild fauna species.
- No. 74 (1999) on the conservation of large carnivores.
- No. 82 (2000) on urgent measures concerning the implementation of action plans for large carnivores in Europe. The Czech Republic, Poland, Romania, Slovakia and Ukraine were recommended to, *"establish a*

framework for technical and political co-operation on large carnivores in the Carpathians that may lead to a co-ordinated management of transboundary populations and to their maintenance in a favourable conservation status."

- No. 100 (2003) on conservation of large carnivores in the Carpathians. This recommendation encouraged the Czech Republic, Hungary, Poland, Romania, the Slovak Republic, Ukraine, Serbia and Montenegro to, "co-operate to jointly prepare a Carpathian Strategy Plan for conservation and management of large carnivores" and to, "draft and implement national action plans for large carnivores."
- No. 115 (2005) on the conservation and management of transboundary populations of large carnivores. The Carpathian brown bear population is listed among "potential candidates for further action".

EU Habitats Directive

The Slovak Republic joined the European Union on 1.5.2004 and therefore became bound by Council Directive 92/43/EEC on the Conservation of Natural Habitats and Wild Fauna and Flora (ABL L 206, 22.07.1992), which is usually known as the Habitats Directive. The main goal of the Directive is to secure species diversity by protection of habitats and species of wild fauna and flora.

According to the Directive, actions have to be taken by Member States to preserve all species of wild fauna and flora and their habitats. The European brown bear is a priority species of the European Union, i.e. it is regarded as a species that needs special responsibility and actions for its conservation. In the Habitats Directive, it is mentioned in Annex II (species requiring specially protected areas), except the populations of Finland, Sweden and Estonia, and Annex IV (strictly protected species; capture, killing and wilful

disturbance is not permitted). The possession, transport and trade with Annex IV species is strictly prohibited.

According to Article 16 of the Habitats Directive, the taking of a limited number of species listed in Annex IV is allowed, "Provided that there is no satisfactory alternative and the derogation is not detrimental to the maintenance of the populations of the species concerned at a favourable conservation status in their natural range."

Member States may derogate from Article 12 and others specifying strict protection for the following reasons:-

- (a) in the interest of protecting wild fauna and flora and conserving natural habitats;*
- (b) to prevent serious damage, in particular to crops, livestock, forests, fisheries and water and other types of property;*
- (c) in the interests of public health and public safety, or for other imperative reasons of overriding public interest, including those of a social or economic nature and beneficial consequences of primary importance for the environment;*
- (d) for the purpose of research and education, of repopulating and re-introducing these species and for the breeding operations necessary for these purposes, including the artificial propagation of plants;*
- (e) to allow, under strictly supervised conditions, on a selective basis and to a limited extent, the taking or keeping of certain specimens of the species listed in Annex IV in limited numbers specified by the competent national authorities.*

Member States making such derogations are required to send a report to the European Commission every 2 years which contains an explanation of the reasons for derogations as well as

“reference to alternatives rejected and scientific data used”. Every 6 years Member States must also report on the implementation of the Directive and the impact of its conservation measures.

European Parliament Resolutions

The European Parliament has no legal authority and so can only make recommendations to the European Commission. Swenson et al. (2000) cited the following Resolutions which make specific reference to bears:-

EP Resolution, 17.02.1989 (A2-339/88, ABL C 69/201, 20.03.1989).

“The European Commission is herewith asked to promote programmes for the protection of the brown bear in Europe and to continue existing programmes. These programmes should cover the whole area of the European Union. In return for protective measures set by communities for the brown bear, actions for socio-economic development will be promoted. Systems for bear damage prevention and damage compensation are supposed to be developed. A connected network of reserves and specially protected areas should be established.”

EP Resolution, 22.04.1994 (A2-0154/94, ABL C 128/427, 09.05.1994).

“The European Commission is herewith asked not to support and finance spatial development with negative impact on bear populations. Actions with negative impact on bear populations should be corrected by the establishment of protected areas and corridors for genetic exchange. Measures against killing and capture of bears and for the protection of bear habitat are supposed to be taken. Financial support for damage compensation and compensation for economic restriction due to bear conservation should be taken.”

Carpathian Convention

At the fifth Ministerial Conference “Environment for Europe” held in Kiev,

Ukraine, in May 2003, Slovakia signed the Draft Framework Convention on the Protection and Sustainable Development of the Carpathians, which stated that, “*The Parties shall pursue policies aiming at conservation, sustainable use and restoration of biological and landscape diversity throughout the Carpathians. The Parties shall take appropriate measures to ensure ... the protection of ... large carnivores.*” The Carpathian Ecoregion Initiative (CERI) worked with the United Nations Environment Programme (UNEP) on drafting the Convention and continues to work towards its implementation. The Convention has been in effect in Slovakia from 4.1.2006 but it is not legally binding.

Biological Diversity Convention

Whilst not mentioning the brown bear specifically, the main objective of the United Nations Convention on Biological Diversity which resulted from the UN Conference on Environment and Development (“*The Earth Summit*”, Rio de Janeiro, 1992) is the conservation and sustainable use of biological diversity. A presupposition is the preservation of ecosystems, natural habitats and wild populations of species of wild fauna and flora. To reach this goal, the following actions have to be taken: identification of specially protected areas; strengthening protection of ecosystems and preserving natural habitats of viable populations; degraded ecosystems have to be restored and the restoration of endangered species has to be promoted. Research for the identification, protection and the spreading of information on the status of biological diversity has to be promoted; protective measures have to be included in planning and development. The Convention has been in effect in Slovakia since 23.11.1994. The EU, of which Slovakia has been a Member State since 1.5.2004, has set itself the objective of halting the loss of biodiversity on its own territory by 2010. Climate change may become the most influential factor (EEA 2006).

Tab. 1.9. Summary of main legislation dealing with brown bears in Slovakia. (* Statutes that are no longer in force but are included in the table to show when certain measures were introduced.)

CITES Convention (Party since 1993)	Bern Convention (signed 1994, ratified 1996)	EU Habitats Directive (EU Member State since 2004)
Annex II: potentially endangered species.	Annex II: strictly protected species (and habitat). (Reservation made at the time of signature to allow hunting.)	Annex II: species of Community interest whose conservation requires specially protected areas. Annex IV: strict protection.
National hunting laws (proposed by Agriculture Ministry)	National nature conservation laws (proposed by Environment Ministry)	
<p>*Act no. 225/1947 on hunting Protected year-round.</p> <p>Act no. 23/1962 (valid 1.3.1962) on hunting Game species (<i>i.e. can be hunted</i>). Classed as “harmful”.</p> <p>*Decree no. 24/1962 (valid 1.3.1962), Decree no. 59/1967 (valid 1.7.1967) Protected year-round (<i>exception needed from Agriculture Ministry for killing, capture, etc.</i>) State pays compensation for damage caused by bears to livestock and beehives if it was reported within 3 days and is judged not to have been the owner’s fault.</p> <p>Decree no. 172/1975 (valid 30.12.1975) Protected year-round (<i>exception needed from Agriculture Ministry for killing, capture, etc.</i>)</p> <p>Decree no. 143/1994 (valid 1.7.1994) State pays compensation for damage caused by bears to livestock and beehives within hunting grounds with no bear hunting or used by the state. In other cases, the hunting ground user pays. The local municipality organises a site inspection by a commission of representatives from the Forest Office, District Nature Protection Office and Slovak Hunting Union. The owner must show that the damage was not his fault. The Forest Office sets the level of compensation.</p> <p>Decree no. 340/1996 (valid 1.1.1997) State compensates damage if hunt not permitted, otherwise hunting ground user must do so.</p> <p>Decree no. 230/2001 (valid 1.7.2001) Protected year-round (<i>exception needed from Agriculture Ministry for killing, capture, etc.</i>) Can be hunted on clear nights up to 3 days before and 3 days after a full moon (<i>hunting at night is normally not allowed</i>). Can be hunted at bait (<i>not allowed for most game species</i>).</p>	<p>*Act no. 1/1955 on state nature protection (valid 3.1.1955), *Decree no. 125/1965 (valid 1.12.1965) on protection of wild animals Protected species.</p> <p>*Act no. 287/1994 (valid 1.1.1995), *Decree no. 93/1999 (valid 1.7.1999) on nature and landscape protection Highly threatened species. Strictly protected species (Bern Convention).</p> <p>Act no. 543/2002 (valid 1.1.2003) on nature and landscape protection (Replaced act. no. 287/1994 and implements EU Habitats and Birds Directives.) Capture, wounding, killing, damaging the habitats etc. of protected animals is prohibited (<i>exception needed from Environment Ministry for killing, capture, etc.</i>). State pays compensation for damage caused by protected species to the life/health of natural persons and to livestock, guard dogs, fish in fish farms/ponds, beehives, forest stands, unharvested crops, some game species in certain circumstances.</p> <p>Decree no. 24/2003 (valid 1.2.2003) Gives conditions under which state pays compensation for damage. Annex 4B: priority species of European importance for which protected areas could be designated. Annex 6A: autochthonous species, “societal value” of 80,000 Sk (<i>c.€2,300</i>) per individual.</p> <p>Act no. 15/2005 (valid 1.4.2005), Decree no. 110/2005 (valid 1.4.2005) on trade in endangered species of wild fauna and flora (Replaced Act no. 237/2002 and Decree no. 346/2002 implementing CITES in national legislation.) Group A: Strictest controls. Agreement of the Environment Ministry is required for import, export and re-export outside the EU, including of trophies, and for the commercial use of bears and bear parts.</p>	

1.2.2. National

The brown bear in Slovakia is both protected and hunted. According to §19 and later amendments of the Hunting Act (no. 23/1962), it is a game species (Tab. 1.9). However, according to Agriculture Ministry Decree no. 172/1975 and later amendments on the time, method and conditions for hunting certain game species, there is no open season for bear hunting. Nevertheless there is an annual, regulated hunt using a system of exceptions from the law. The 1962 Act is still in force, including its archaic classification of predators such as the bear as “*harmful*” species. A new law on hunting has already been in preparation for several years but has yet to be finalised.

According to the Nature and Landscape Protection Act (no. 543/2002) and Environment Ministry Decree no. 24/2003, which implement EU Habitats and Birds Directives, the brown bear is a protected, priority species of European importance. It is forbidden to disturb protected species, especially to kill, injure, capture or relocate them. It is also forbidden to destroy or damage their habitats and dwellings, especially dens. However, exceptions are issued by the Environment Ministry every year in order to allow population control by a planned harvest as well as the removal of problem bears.

Provision for the compensation of damage caused by bears to livestock and beehives, provided that certain conditions are met, has been included in hunting legislation since 1962. The 2002 Nature and Landscape Protection Act expanded this provision to cover other forms of damage, such as to crops and the costs of treatment of injuries inflicted by bears on people, as well as damage caused by other protected species.

In the Red List of Mammals for the Slovak Republic, the brown bear is listed

as “*lower risk, conservation dependent*” (Žiak and Urban 2001). Under a previous piece of legislation (Decree no. 93/1999, Appendix 4), which is no longer in force, it was included among “*highly threatened species*”, the second of 3 categories.

CITES is currently implemented in national legislation by Act no. 15/2005 and Decree no. 110/2005 on Trade in Endangered Species of Wild Fauna and Flora which place the brown bear in Group A, species with the strictest controls. The import, export and re-export outside the EU of bears and bear parts, including trophies, and their commercial use require agreement from the Environment Ministry.

The “*societal value*” of bears in Slovakia is set by Decree no. 24/2003 as 80,000 Sk (c.€2,300) per individual. This value, according to Act no. 543/2002, “*defines mainly their biological, ecological and cultural value that is determined taking into consideration their rareness, threat and performing of non-production functions.*” The value is used, for example, when assessing the seriousness of an infringement of the law involving a protected species.

Act no. 543/2002 also broadly defines the assessment of the favourable status of species and habitats, levels of protection for territories and species and various types of protected areas.

Other major legislation affecting bears and/or their habitats includes Act no. 326/2005 on Forests, Act no. 488/2002 on Veterinary Care (including of wild animals), Act no. 237/2000 on Area Planning and Building Code and Act no. 24/2006 on Environmental Impact Assessment. A new hunting law is likely to be passed in the near future (see 3.5.3). Amendments to legislation on forestry, trade in endangered species and nature and landscape protection have been passed recently.

1.3. Socio-economic

1.3.1. Danger to humans

Defensive attacks

The size and physical strength of bears enable them to seriously injure or even kill humans. Most bears avoid people but attacks do sometimes occur and present a particular challenge to human safety with major implications for bear conservation (Quigley and Herrero 2005).

European brown bears seem to be much less aggressive than those found in North America and east of the Ural Mountains. There are records of 12 people killed during the 20th century by brown bears in Europe outside Romania (where 24 people were killed), compared to 206 in Asia and 71 in North America (Linnell et al. 2002a). Attacks on humans in Europe are almost all by bears defending themselves, their cubs or their food. The presence of a wounded bear is the most dangerous situation. Other factors increasing the likelihood that a bear will act aggressively, in decreasing order of importance, are: the presence of cubs; presence of carrion; a surprised bear; a bear at its den; presence of a dog (Swenson et al. 2000).

There are no known cases of a bear killing a person in Slovakia since the bear population recovered (Hell and Slamečka 1999), but there are injuries in most years, some people requiring an extended stay in hospital and suffering lasting effects. There are records of an average of c.9 people per year injured by bears in 1985-87 (Hell and Bevilaqua 1988), which seems to be a higher rate than in recent years (R. Rigg unpub. data). Many of the injuries are caused by bears attacking defensively, typically during encounters with hunters, forest workers or people picking mushrooms or berries. Sometimes people are injured by nuisance bears, but predatory attacks are so far unknown.

The Slovak Hunting Union conducted a questionnaire survey in 2004 on bear

attacks (Šebo 2004). Survey respondents described a total of 33 attacks from the period 1972-2002. Allegedly, 46% of attacks were by females with cubs. Hunters were involved in c.40% of cases, but this result might be influenced by survey design. Just over 20% of attacks occurred when bears were pursued by hunting dogs and beaters or had been injured by shooting and a further 15% were by startled or otherwise disturbed bears. In over 80% of all cases, the bear was said to have begun to attack from a distance of 1-20 m, although there was a case in which a female with cubs was said to have charged from a distance of 150 m.

Outcomes of encounters and attacks are often influenced by the responses of those involved. In Poland, bears responded with an *“attack or aggressive attitude”* 4 times more frequently toward people who were *“active”* (approached to photograph, tried to chase away) compared to those who were *“passive”* (watched, stayed quiet, withdrew) in encounters (data in Jakubiec 2001). Apart from those by nuisance bears, (see below) most attacks in Slovakia are defensive. If actual contact is imminent, leading international experts recommend a passive defence: lying face down on the ground, arms and hands protecting the head and neck, and remaining still until the bear leaves the area. Fighting back could prolong a defensive attack and increase the chance of serious injury (Herrero 1985, Quigley and Herrero 2005).

Slovak foresters and hunters often shout at bears in sudden encounters; Bevilaqua (1985) recommended this. A hunter was injured in Malá Fatra in September 1967 when he came close to a bear at a carcass. He repeatedly tried to reach his gun and was attacked 5 times (Bevilaqua 1985, 1995 p.103-104). Another hunter described to the press how, when attacked by a female on 23.10.2004, he fought back until his companion shot and killed the bear.

Most people confronted by an attacking bear in the cases described by Šebo (2004)

reacted by shouting, calling for help, trying to run away or climb a tree or by shooting a gun to stop the bear or scare it away. Apart from when the bear was shot, none of these responses seemed to be successful at halting attacks. Weapons were an unreliable defence: in some cases, hunters participating in a group hunt for wild boar were unable to react in time to shoot despite seeing an approaching bear at a distance of 60-80 m. Some hunters or poachers were injured when tracking down a bear that had escaped after being shot.

The longest known stay in hospital (50 days) in connection with a bear encounter in Slovakia was not due to a bear attacking with its teeth or claws but was the result of the bear, disturbed at its winter den by a hunter, colliding with and crushing him as it fled (Šebo 2004).

Hunting advocates frequently claim that danger to humans is a consequence of bears having become “*overpopulated*”. This is misleading, as bears were shot in self-defence during encounters even when there were far fewer bears, for example on 22.5.1897 and 19.1.1976 (see Karč 2007). Since 1.1.2003 the state has been liable by law (Act no. 243/2002 §97) to compensate the injury or death of persons caused by specified protected species, including the brown bear.

Food-conditioned “nuisance” bears

As omnivores, brown bears are attracted to many types of human food as well as refuse, creating the potential for them to be problematic if preventive measures are insufficient. The attraction of bears to human food and refuse has been associated with many serious bear-inflicted injuries in North America (Herrero 1985). There have been similar cases in Slovakia. Nuisance behaviour by bears in the High Tatras was first noticed in the 1960s and became more common as visitor numbers increased (tourism data from Šturcel in Mihál 1985). Nuisance bears injured c.20 people in central Slovakia in 1975-87 (Teren 1987a).

Twelve percent of attacks analysed by Šebo (2004) were by human habituated and food-conditioned bears.

Subadults and females with cubs are most likely to become food-conditioned (Fig. 1.9; Kováč 2003). Some particular localities or types of locality are prone to conflicts. In a contemporary hunting magazine article, F. Bevilaqua described damage and injuries caused by nuisance bears in the mid-1980s at Tále-Trangoška in Nízke Tatry, where there continue to be similar problems (Rigg 2002).

Deliberate feeding of bears has been implicated in many instances of bears becoming food-conditioned (Hlaváč 1995, Kováč 2003), including cases in which people were injured. For example, a 3-year old was regularly hand-fed by tourists in Veľká Fatra for several months until it injured someone and was shot on 20.7.1972 (Teren 1987b). Similar cases are known from tourist resorts in the High Tatras in the 1980s (in lit.). In September 1986 at least 2 people were attacked by a bear (possibly a female with cubs) in their tents at a campsite in Račková dolina, Západné Tatry (Bevilaqua 1995). Staff of a nearby hotel had hand-fed bears (Hell and Slamečka 1999 p.84, 99-101); refuse is still badly stored there, attracting bears (R. Rigg pers. obs.). In summer 2002 a female that frequently fed on refuse in Tále-Trangoška, and that was given food by tourists and hotel workers, injured people in their tents (Rigg 2002).

That such cases are not merely a result of there being more bears is shown by the fact that bear-proof bins in Demänovská Valley have reduced problems there (R. Rigg pers. obs.), despite an increase in estimated bear numbers in Nízke Tatry since the 1980s (Fig. 1.3). There have been fewer instances of problem bears in the High Tatras since the forest cover around most tourist resorts was drastically reduced as a result of a storm on 19.11.2004 (Kováč in Burdová 2007).

1.3.2. Economic impact

Damage

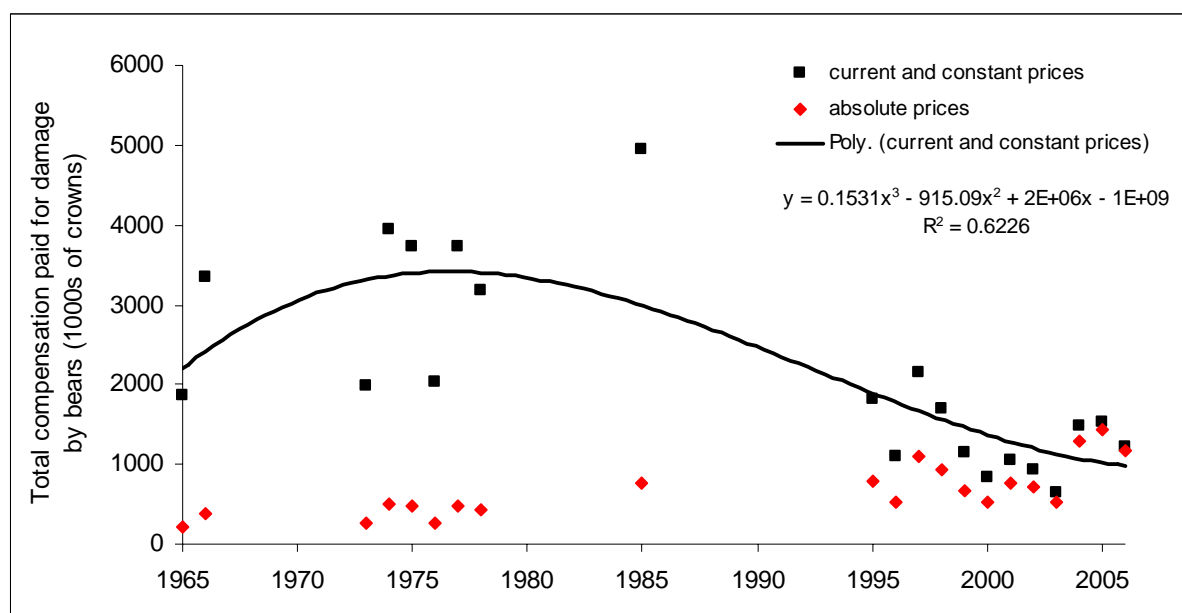
The damage they caused to agriculture was one of the main reasons for the historical persecution of bears in Slovakia (Karč 1977), as elsewhere in Europe (Breitenmoser 1998), which almost led to their eradication. The recovery of the bear population in the West Carpathians has been accompanied by the re-emergence of this ancient conflict. Since 1962 the state has paid compensation for damage (until 2003 only for that caused to livestock and beehives) and a regular legal harvest of bears was resumed at the same time partly with the intention of limiting damage by controlling population size (Janík 1997, Martínková and Zahradníková 2003).

Economic damage is inconsequential on a national scale (Fig. 1.14). The total compensation paid per year has rarely exceeded 1 million Sk (c.€28,500). This

figure is dwarfed by agricultural subsidies, which in 1999-2001 totalled c.1% of GDP per annum (MP SR 2002), four orders of magnitude greater than compensation for bear damage.

Figure 1.14 shows that, while the total annual compensation payments for damage in absolute values have increased, the real value of economic damage by bears after adjusting for inflation has fallen to c.44% of levels in the 1960-70s. Numbers of beehives reportedly damaged by bears were lower in 1997-2005 than in the 1960-70s while losses of sheep or goats were similar (Tab. 1.10, Fig. 1.15). Damage to cattle, which according to Janík (1997) was the main source of conflict at the time when hunting was reintroduced, has been negligible in recent years. In 1998-2006, losses of sheep/goats accounted for 44.3% of compensation payments, beehives 40.2% and cattle/horses 11.1% (Fig. 1.16).

Fig. 1.14. Total annual compensation payments for damage attributed to bears since 1965 in absolute prices as well as adjusted to current and constant prices using annual inflation rates provided by the Statistics Office of the Slovak Republic. Data were not available for all years. Figures for 1965-1985 are in Czechoslovak crowns (Kčs); those from 1995 onwards are in Slovak crowns (Sk). At the time of writing €1 ≈ 35 Sk. Sources: Šprocha 1977, Sabadoš and Šimiak 1981, Servheen 1989, Volček in lit., Somorová 1997, Kassa 1999a, 2001b, 2002b, Kassa in Pilinský 2001, SNC records. (Sources are sometimes inconsistent: e.g. according to Sabadoš and Šimiak 1981, compensation in 1974 totalled 502,805 Kčs, whereas Šprocha 1977 gave the figure as 420,930 Kčs.)



Tab. 1.10 Hunters' reports of beehives damaged and livestock killed by bears during the period 1966-2005. Data were not available for all years. Sources: Jerguš 1972, Dubovský in lit., Hell and Slamečka 1999, Farkáš et al. 2001a,b, Lehocký et al. 2003a, Šebo 2003, Hell et al. 2005, Lihocký 2006.

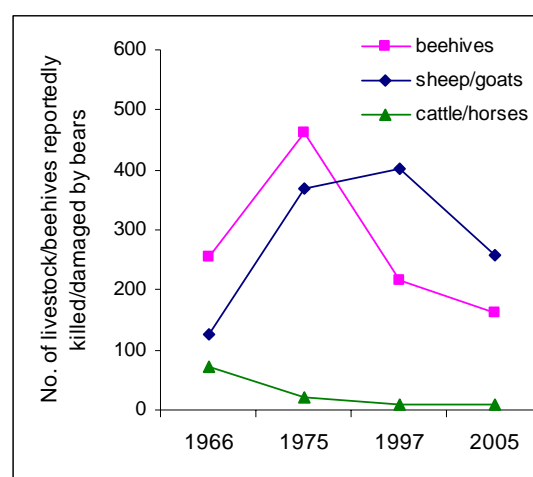
Year	No. damaged/killed by bears		
	Beehives	Sheep/goats	Cattle
1966	254	125	71
1975	463	369	21
1997	216	402	9
1998	310	253 (all livestock)	
1999	140	217 (all livestock)	
2000	112	260	10
2001	220	272	9
2002	233	329	15
2003	117	168	15
2005	163	259	8
Mean	223	273	20

Rigg (2004a) found that losses of sheep were related more to the availability and vulnerability of sheep than bear numbers. In 1870, when conflicts between bears and shepherds were apparently much greater, there were 2.7 million sheep in Slovakia, 8 times more than at present. According to official figures⁴, numbers of livestock and beehives fell from 700,000 sheep, 1.3 million cattle and 390,000 colonies of bees in 1970 to 320,500 sheep, 528,000 cattle and 270,000 colonies of bees in 2005. In many regions, livestock is now grazed nearer to villages, further from forest cover, than was typical in the past and more flocks are brought into farmyards or barns each night.

On the basis of shepherds' reports, it has been estimated that in 2001-03 bears killed between 160 and 400 sheep per year in Slovakia (an average of < 0.5 sheep per bear), which is less than 0.2% of those

grazed in regions with bears (Rigg 2004a, Rigg and Gorman 2006b). For comparison, the rate of bear predation on livestock in northern Slovakia in 1956-64 was estimated at 0.5-0.7 sheep and c.0.3 cattle/adult bear/year (Jamnický 1988b). During that period there were substantially fewer bears but far more livestock than at present. Flocks were commonly grazed on mountain pastures in close vicinity to forest cover and so were at greater risk of attack by large carnivores.

Fig. 1.15. Trends in hunters' reports of damage by bears. Sources: see Tab. 1.10.



Less than 20% of flocks are affected annually. Most losses occur in late summer and autumn. Attacks are almost always at night and in over 60% of cases 1-2 sheep are killed. There are strong correlations between the level of losses at farms and methods of night confinement and other preventive measures used. Only a small proportion of farms are chronically affected by bear (and wolf) predation but they account for a high percentage of total losses (Rigg 2004a). Problem individuals sometimes arise. A large, old male bear in the Polish East Carpathians allegedly killed more than 70 cattle and horses during 5 months in 1971 (Sumiński 1976).

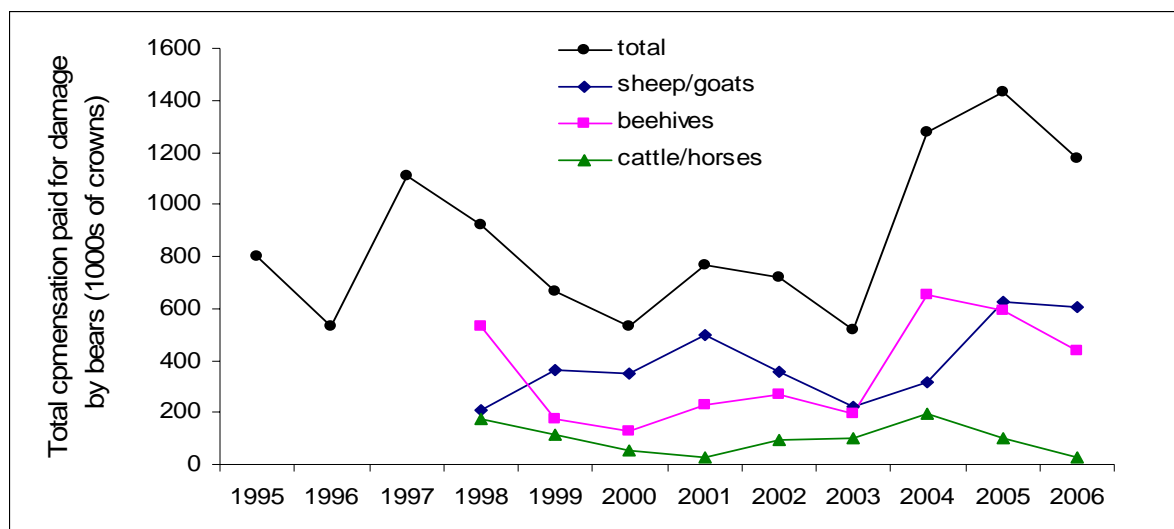
Bear damage to orchards and crops is common, but not as well documented as damage to beehives and livestock because

⁴ <http://www.statistics.sk/>

until a new law became valid in 2003 such losses were not eligible for compensation. Recently it has mainly concerned fields of maize planted in mountain areas, often

near forest edges. In 2004-06, damage to crops accounted for 4.3-7.9% and damage to fruit trees 1.5-3.8% of all compensation paid per annum (SNC records).

Fig. 1.16. Category and amount of compensation paid for damage attributed to bears in 1995-2006. Totals for 2004-06 each include c.115,000 SKK (c.€3,300) for damage to crops and fruit trees (up to 2003 this type of damage was not usually compensated). Sources: Kassa 1999a, 2001b, 2002b, SNC.



Hunting revenue

In parts of northern Europe, bear predation on wild ungulates, especially elk (*Alces alces*), is a source of competition with human hunters. Bears seem to kill few ungulates in the Carpathians. The level of damage to game species reported by hunters in Slovakia is trivial: in 1997-2002 it averaged c.29,000 Sk (c.€850) per annum (Šebo 2003). Compensation for such losses has been available by law since 2003, but no claims have been made (M. Adamec pers. comm.). Only 1.4% of 5,626 known ungulate deaths in Tatranský National Park in 1954-91 were attributed to bears (Kováč 2003). Scat analysis has confirmed that neonate deer and wild boar are consumed by bears (Rigg 2004a). Because they are often completely consumed, their remains are unlikely to be found in the field.

There are several other relatively minor conflicts with hunters. Bears sometimes break into feed stores or feeders and

consume stores of ungulate winter feed (Král 2001, Lihocký 2006). In justifying their applications for bear hunting, some hunting organisations have complained that bears disturb or displace ungulates, or cause them to have fewer young. However, in the Tatra Mountains, red deer have been observed feeding or passing within 100 m of bears with little visible concern (e.g. R. Rigg pers. obs.).

On the other hand, the presence of bears not only provides hunting opportunities and trophies for hunters but also generates income. It is clear from the minutes of the 22.2.2001 meeting of the Commission for Large Carnivores (Pilinský 2001a) that this is one of the main motivations of those wishing to conduct bear hunts. Fees for bear hunting currently advertised by the State Forestry Service⁵ are shown in Tab. 1.11. Prices charged by private hunting companies are similar.

⁵ <http://www.lesy.sk/showdoc.do?docid=477>

Using this price structure, the total fees paid by trophy hunters for the 35 bears shot in 2005 would have been 4.8 million Sk (€137,000). This is c.3.5 times more than total compensation paid for damage attributed to bears in the same year.

Hell (2003) proposed that a portion of hunter fees should help fund conservation, management, research and damage prevention measures such as livestock guarding dogs and electric fences. Hlásnik (2002) thought hunters would not give up more than 10% of fees for this purpose.

Tab. 1.11. Fees currently advertised for bear hunting by the State Forestry Service.

Weight of shot bear (kg)	Fee	
	SKK	EUR
up to 60	64,300	1,850
61-80	80,800	2,300
81-100	110,500	3,150
101-120	154,500	4,400
over 120	154,500	4,440
	+2,000/kg	+55/kg
	over 120 kg	over 120 kg

According to the Agriculture Ministry's Green Report (MP SR 2005), the hunting sector made a slight loss overall in 2005. Approximately 1.1% of the country's population are registered hunters. This is less than in two thirds of other European countries (Hell 2005). Hunting grounds cover 90.5% of Slovakia, including National Parks and other protected areas. According to the National Forestry Centre in Zvolen and the Statistics Office of the Slovak Republic, 45% of the total area of hunting grounds is forest land and 52% is agricultural land. In 2005, 19% of hunting ground area was managed by the State Forestry Service and an additional 24% was also state-owned. The proportion of hunting ground area in private ownership increased from 9% in 1997 to 14% in 2005 while that of agricultural co-operatives fell from 26% to 15% in the same period.

Wildlife tourism

Hunting companies and Forestry Service employees have used artificial feeding sites in Tatranský and Nízke Tatry National Parks to raise revenue from bear watching, without National Park authority approval and sometimes of questionable legality. Local communities and bears are unlikely to have benefited from such activities, as profits tend to be retained by the individuals and companies involved. Nor has there been any benefit in terms of education or attitudes, as the public is unaware of this business and some guides tell clients that bears are "*overpopulated*" (R. Rigg pers. obs.). Allegedly, there have been cases in which those running such operations charged tourists to view bears at feeding sites in spring and then organised trophy hunting at the same sites in autumn.

A legitimate bear watching programme could produce funds for bear conservation initiatives and, if it directly benefited local communities, might also help to increase tolerance of bear presence. Wechselberger et al. (2005) found more positive attitudes among people who had seen bears in the wild compared to those who had not.

Since 2000 the Slovak Wildlife Society has been operating low impact *Wolves, Bears & Eagles* wildlife holidays and conservation volunteering opportunities. In both cases, all profits have been donated either to related conservation and research projects or to local communities through the Society's Carnivores for People fund⁶.

Other effects

Steyaert (2006) has partially described a positive influence that brown bears have on fruit-bearing plants and ecosystems in which they occur by dispersing seeds, particularly *Vaccinium myrtillus*. In recent years, the collection of forest fruits by local residents has increased in popularity and, for some, is a source of income.

⁶ <http://www.slovakwildlife.org>

1.3.3. Attitude, opinion, knowledge

The Slovak Wildlife Society conducted a survey of public opinion, knowledge and attitudes towards bears, wolves and lynx as well as their conservation and hunting management in Slovakia in 2003-04 (Wechselberger et al. 2005). The survey was administered in a core area of large carnivore occurrence (Liptovský Mikuláš district) and a control area where large carnivores are rare or absent (Nové Mesto nad Váhom district).

The majority of respondents ($n = 1,178$) held neutral to positive attitudes toward large carnivores. The vast majority of respondents (82.9%) agreed that, "*Bears, wolves and lynx belong in the wild in Slovakia*". The bear was accepted more than the wolf but less than the lynx. Two thirds of respondents thought that it is good that there are bears in Slovakia.

Socio-demographic factors partially affected attitudes: males were significantly more knowledgeable about and positive toward large carnivores than females. People over 60 years of age had the most negative attitudes whereas those between 16 and 35 years of age had the most positive attitudes. Attitudes were more negative in villages than in towns. Higher levels of education tended to be associated with more positive attitudes but the difference was not statistically significant. In terms of occupation, foresters were the most positive and shepherds the most negative toward large carnivores.

Of the 4 target groups sampled, the most positive was "*tourists*", followed by "*residents*" (over 16 years of age), "*pupils*" (12-15 years old) and "*woods people*" (shepherds, farmers, hunters, foresters, staff of mountain tourist facilities). Compared to the other target groups, woods people most often considered there to be too many bears and thought carnivores cause a lot of damage.

Fear seemed to be an important factor influencing attitude: 49.2% of all respondents indicated that they would be afraid to go into the woods if there were bears, 48.1% if there were wolves and 38.0% if there were lynx. Very fearful people had the most negative attitudes.

The bear was considered the most dangerous species and was most feared. Two thirds of respondents answered that it is (very) dangerous and 55.9% thought so of wolves. The danger of bears was rated higher but that of wolves and lynx lower in the core versus control area. Quite a high proportion of people did not know how to behave appropriately during an encounter.

The bear was most often considered to be "*overpopulated*" (by 27.6% of respondents, versus 19.2% for wolves and 7.6% for lynx). Although 40.9% of respondents in the core area (compared to 15.5% in the control area) thought there were too many bears, more of them underestimated the population size (31.9%) than overestimated it (10.7%).

More than three quarters (78.2%) of all participants, including 78.0% in the core area and 70.2% of woods people, agreed that hunting of bears, wolves and lynx should be strictly regulated. Over 71% agreed or tended to agree that National Parks should be places where animals are protected year-round, a significantly higher proportion in the core area than in the control area.

A lack of education/information and problems with people were identified as the most important current issues. Over 90% of respondents wanted to learn more about large carnivores. Most respondents wished to obtain more information via television/radio. Newspapers, magazines, excursions, leaflets, the internet and books were also popular media.

Jób (2007) has recently obtained similar results in another large carnivore core area.

1.4. Threats to bears

The West Carpathian sub-population is quite numerous, not completely isolated and appears to be stable or continuing to increase in size and possibly also range. Its viability therefore seems to be high and it is largely untroubled by imminent threats facing several small, remnant populations in western and southern Europe.

However, connectivity between the West Carpathian sub-population and the East Carpathian sub-population appears to be weak. The latter is in any case probably numerically smaller and in Ukraine appears to have declined substantially in recent years due to poaching and habitat loss (Wasidlow in Rigg 2005b).

Key threats to the Carpathians in general as identified by UNEP⁷ include increased unemployment and poverty, unsustainable development patterns, over-exploitation of natural resources, pollution, deforestation, excessive hunting and habitat loss and fragmentation. In its summary of a National Ecological Network (NECONET)⁸ for Slovakia, the World Conservation Union (IUCN) listed the most important threats to the gene pools of animals in the country as:-

- (a) *degradation and destruction of natural habitats by large-scale agriculture, drying out of marshlands, improper forestry practices (e.g. clear-cuts), construction of large water-works, urbanisation, building of industrial works and motorways, regulation of waterways;*
- (b) *influence of emissions and application of chemicals (mainly in agriculture) resulting in foreign substances in the environment (pesticides, heavy metals, emissions);*
- (c) *intensive large-scale agriculture and mechanisation, intensive pasturing;*

- (d) *eutrophication and pollution of water, meliorations and other hydrologic changes,*
- (e) *loss of continuity caused by construction of buildings, road networks and communications networks;*
- (f) *direct influence of transport (collisions with vehicles, noise);*
- (g) *hunting, fishing and poaching, losses of animals on migration routes;*
- (h) *collection for commercial purposes, threatening hibernation sites and other direct liquidation of animals by man;*
- (i) *certain kinds of sports and recreation (threatening mainly mountain species), disturbance of threatened species' habitats (by tourism, photography, etc.);*
- (j) *threatening hibernation sites and direct liquidation by man;*
- (k) *climate changes.*

The Safari Club International's *European Brown Bear Compendium* (Linnell et al. 2002) identified the following major proximate threats faced by bears in Europe:-

- (1) *Excessive human-caused mortality;*
- (2) *Fragmentation of habitat;*
- (3) *Infrastructure;*
- (4) *Habitat degradation;*
- (5) *Artificial food sources;*
- (6) *The demographic and genetic viability of small populations;*
- (7) *Public attitude;*
- (8) *Fragmentation of management authority;*
- (9) *Insufficient monitoring of bears.*

Of the most important issues, threats and obstacles for the conservation of the brown bear identified in the Council of Europe's pan-European action plan (Swenson et al. 2000), the following apply specifically to Slovakia:-

- *Bear hunting, legal killing of nuisance bears, poaching;*

⁷ <http://www.unep-wcmc.org/>

⁸ <http://www.iucn-ce.org/econets/database/?id=14>

- *Habitat loss;*
- *Forestry;*
- *Fragmentation and isolation of habitat;*
- *Increased human access to bear habitat;*
- *Livestock husbandry and farming;*
- *Fragmentation of management authority;*
- *Artificial food sources;*
- *Public opinion.*

The following is a brief assessment of threats specifically to bears and their habitats in Slovakia.

Excessive human-caused mortality

Approximately 90% of known bear mortality in Slovakia is human-caused (Tab. 1.7). Four-fifths of all known mortality is due to legal hunting. Although natural deaths, especially those of cubs, are less likely to be discovered, it is clear that humans have a major direct impact on bears.

The present level of legal harvest seems to be sustainable: the population has continued to grow despite the resumption of hunting in 1958-62. Nevertheless the importance of sufficient monitoring and strictly limiting hunting is shown by the near-eradication of bears by the effects of unregulated and excessive hunting and persecution in the early 20th century.

Linnell et al. (1998) concluded that legal harvest of bears need not be a threat to population viability if properly managed and is probably not a problem for any bear population in Europe at present. Recent quotas in Slovakia are probably set at or slightly above the maximum sustainable yield (see 1.1.8), which suggests that population growth has been possible because quotas have not been filled. According to Linnell et al. (1998), greater availability of population-specific scientific knowledge should improve management in general, but developing

effective programmes is hampered by the intrinsic difficulties in monitoring bear populations.

Hunting may have less obvious or well understood effects, for example on population structure, demographics, life history traits and evolution (Swenson 2005, Linnell et al. 2006). Group and/or night-time hunting of wild boar can disturb bears and occasionally lead to accidental shooting. Disturbance of denning bears can also result in increased mortality.

Besides legal hunting, traffic accidents and poaching are important sources of human-caused mortality. Fatal collisions with vehicles appear to be increasing. In recent years, bears have been killed while crossing roads or railways in order to reach fields of maize. Poaching is probably more common than known cases suggest. Hell (2003) thought that the actual level of poaching might be nearly as high as the legal harvest, and may be compromising the connectivity of the West and East Carpathian sub-populations in eastern Slovakia, where evidence of trapping has been found (K. Soóš pers. comm.).

Habitat loss, degradation, disturbance

The recovery of the bear population in the West Carpathians was possible due to the continued, and to some extent increased, availability of suitable habitat. Loss, degradation and fragmentation of habitat are likely to be important problems in the mid- to long-term.

Bear distribution in Europe is closely linked to forest cover so forested areas hosting bears or serving as dispersal corridors need to be identified and protected. While the total area of forest land in Slovakia has increased in recent years, some forestry practices may have caused degradation of habitat quality, such as logging of natural and semi-natural forests, particularly deciduous and mixed stands, and replanting with less varied stands poorer in bear food sources.

Another major threat from forestry is increased human access to bear habitats as a result of forest road construction and habitat change. Forest road and tourist trail density has been identified as an important factor influencing bear distribution. Models have suggested that > 0.6 km of forest roads or trails per 1 km^2 in areas with little topographic relief and > 1.2 km/km² in areas with varied relief have prevented permanent occupation of habitat by bears (Janík 1997).

More human access is likely to result in more poaching, disturbance of bears and further habitat degradation, for example due to the intensive collection of forest fruits and construction of holiday cottages (Halák 1993, Swenson et al. 2000).

Even habitat which is not severely degraded may become unavailable to bears if human use is too intense. Bears appear to have been displaced from parts of Slovenský ráj National Park with dense networks of highly-frequented hiking trails (Gočál 1989). Greater affluence has led to highly disturbing recreational activities such as off-road driving and motorcycling.

Habitat fragmentation

Habitat considered suitable for large carnivores is already rather fragmented in Slovakia (Salvatori 2003) and is becoming more so due to urban sprawl, continued development of tourism infrastructure in and around protected areas as well as road building and enlargement. Highway construction between southern Poland and northeast Slovakia could permanently isolate the West Carpathian sub-population from the East Carpathian sub-population. If barriers become impermeable to bears, the West Carpathian sub-population could itself be split into several smaller sub-populations, each with diminished demographic and genetic viability.

“Green bridges” and underpasses designed to mitigate the negative impact of transport corridors are used by bears in, for example, Croatia and Canada. “Green

bridges” should be at least 50 m wide, located ideally on traditional wildlife trails and with sufficient cover on both sides (van Maanen et al. 2006).

The need to incorporate wildlife crossing structures in new highways was among the recommendations of the 1995 conference on *Research and protection of mammals in Slovakia* (Urban 1995). The State Nature Conservancy has produced a manual on the subject (Klescht and Valachovič 2002). Environmental Impact Assessments for some sections of highway have nevertheless largely ignored the possible fragmentation of habitats of wide-ranging species and the issue has generally received insufficient attention from the government, the Highways Agency⁹ and Doprastav¹⁰, which is the country’s largest construction company and is responsible for much of the recent road building.

Bear-human conflicts, public attitudes

Bears may persist in certain areas despite, or even because of, high human use. This often leads to conflicts due to damage, fear and threats to human safety, in turn resulting in increased bear mortality. Although economic damage caused by bears is insignificant on the national level and the impact on the bear population of the loss of problem individuals has probably also been minor, such cases receive widespread and sensationalised publicity in the mass media. Large numbers of reports on the same events give the impression of there being far more incidents than have actually occurred and journalists rarely make much effort to give context and scale to the issues they cover (Rigg 2002). The majority of the public is not aware that compensation is paid for damage caused by bears (Wechselberger et al. 2005, Jób 2007). The response of the media and public following some recent cases of

⁹ <http://www.ssc.sk/>

¹⁰ <http://www.doprastav.sk/>

people injured by bears has at times resembled a hysterical witch hunt.

Problems with bears have tended to be emphasised and sometimes exaggerated by hunting advocates calling for less restrictions on hunting to allow a larger harvest. The constantly repeated argument that bears are “*overpopulated*” has influenced public opinion (Wechselberger et al. 2005), hindering efforts to increase the use of non-lethal preventive measures to reduce danger and damage.

An over-reliance on lethal control has sometimes been compounded by slow or inadequate responses of state authorities to specific cases. There seems to have been a lack of consistent, pre-planned approaches to recurring situations (Rigg 2002). For example, the need to use preventive measures to secure refuse and livestock from bears has been highlighted since at least the 1980s (Žilínek 1987, Gočál 1989) and yet application continues to be sporadic. Poor waste management and the direct feeding of bears have led to human injuries and bear deaths. In several instances, people involved in bear attacks were breaking protected area regulations at the time they occurred (Rigg 2002).

If conflicts and their associated media coverage and propaganda significantly decrease public acceptance of bears, it may become difficult to find sufficient popular and political support and public funding for complex and costly measures important in the long-term, such as the construction of “green bridges”.

Although Jamnický (1988b) argued that the decline of livestock breeding in Slovak mountains has reduced the food base of bears because cattle carcasses are no longer common on mountain pastures, predation on livestock was historically a major source of bear-human conflicts which led to persecution of bears (Jamnický 1993). International experts have identified livestock breeding as a major obstacle to bear conservation

(Swenson et al. 2000) and its decline has therefore probably benefited bears overall.

Division of management

Whilst the effective conservation of species that occur at relatively low population densities and have large home ranges requires co-operation that covers administrative units at all scales, including the international level, there is a tendency for increasing democracy to lead to responsibility for wildlife management being passed down to more local levels. Without effective co-ordination this can result in severe problems for population-level management (Linnell et al. 2002b).

In Slovakia, recent bear management has been coordinated on the national level. However, the sharing of responsibility between the Environment Ministry and the Agriculture Ministry, which have fundamentally different approaches to wildlife management, has resulted in a constant struggle to implement contrasting strategies. Records are also split between different institutes, making the objective analysis of data a complex task.

Lack of knowledge and expertise

There has been a paucity of research on bear ecology in Slovakia and as a result there is a general lack of expertise on bears. Almost none of the articles written about bears in Slovakia examined during the preparation of this report would meet international standards for peer-reviewed scientific publication. Participation of representatives from Slovakia in the Large Carnivore Initiative for Europe (LCIE) has been sporadic. The only participant from Slovakia to attend any of the International Association for Bear Research and Management's conferences in the last 5 years was from a not-for-profit NGO, the Slovak Wildlife Society.

Weak engagement in leading international forums, as well as economic, political and language barriers, has hindered information flow to bear

managers, researchers and educators. As a consequence, the public knows very little about bears and there is an almost total lack of knowledge about non-lethal preventive measures and bear safety (Wechselberger et al. 2005).

Whereas state institutes and NGOs in many EU member and candidate countries used LIFE¹¹, the Financial Instrument for the Environment, to fund research, capacity building, conflict mitigation, education programmes and other carnivore conservation measures, this opportunity was missed in Slovakia. The LIFE+ programme may present a second chance.

It sometimes seems that the paucity of high quality data and robust analysis is convenient for lobbying groups. In such a situation they can present their often self-serving arguments in the knowledge that there is little factual information available to refute them. Many hunters and hunting advocates have engaged in what may be fairly described as scare-mongering to garner public opinion in favour of a cull. Emotive claims are constantly repeated that bears are “*overpopulated*”, conflicts are the result of too many bears and therefore the only solution is to relax restrictions on hunting and increase quotas. Reactionary campaigns from animal rights and environmental activist groups have been equally lacking in factual content and objectivity. They also risk undermining progress made by the State Nature Conservancy in limiting the potentially negative effects of hunting by hard-won compromises. Constantly focussing the debate on bear population size has also impeded efforts to improve bear-human coexistence, such as the educational and conflict resolution work of the Slovak Wildlife Society’s *BEARS Project*.

Whilst the SNC and Environment Ministry have so far resisted much of the pressure from hunting advocates, some

recent decisions seem to have been made with the intention of appeasing public opinion or specific interest groups rather than on scientific grounds.

Corruption and conflicts of interest

Corruption is widespread in Slovakia at all levels of society. It could have an impact on bear conservation in a variety of ways. In recent years there have been several publicised cases of politicians accepting bribes. Due to their illegal and therefore secretive nature, it is difficult to assess the extent of such activities, but situations may well arise in which measures to protect habitats and species are circumvented.

Since the Communist period, arranging illicit bear hunting seems to have been a way to reward associates. Hunting advocates such as Hell and Slamečka (1999) have pointed out several ways in which the hunting system has been commonly abused, including shooting bears of different weights than specified in quotas, falsifying records and not declaring all bears that were shot.

There are also other types of situations which, whilst perhaps not illegal, represent important conflicts of interest. Some SNC staff, including National Park zoologists responsible for administering bear hunting management, are also hunters. In some cases this appears to have influenced their recommendations on hunting management. Several appointments made in 2006-07 to key posts in the Environment Ministry, State Nature Conservancy and other authorities and organisations appeared to be of a political nature intended to weaken opposition to commercial interests.

The lack of modern research and management projects seems to have been partly a result of reluctance to co-operate rather than compete. The effectiveness of some projects conducted in recent years was compromised by particular individuals seeking to maximise their own personal gains to the detriment of broader goals.

¹¹ <http://ec.europa.eu/environment/life/home.htm>

Summary and evaluation of status

The West Carpathian sub-population, shared by Slovakia, Poland and the Czech Republic, has naturally recovered from an isolated relict population of around 20-60 bears 75 years ago to a current total of c.800 individuals, more than 95% of them in Slovakia. The recovery was facilitated in the first instance by a ban on hunting in 1933-1957, helped to various degrees by increases in forest cover and numbers of ungulates (and wolves), abandonment of fields and orchards, decline of livestock grazing and supplementary feeding.

Since the 1970-80s there has probably been renewed exchange of individuals with the East Carpathian sub-population, which is thought to number c.400 bears, c.6% of them in Slovakia. Exchange is probably mainly in Poland and involving mostly subadults and/or males. Connection between the 2 sub-populations in Slovakia seems to be fairly weak. Poaching and/or habitat variables could be limiting factors.

Considering the West Carpathian sub-population as a whole, the total occupied range seems to be c.16,500 km² suggesting an average density of c.5 inds./100 km². Habitat is fragmented resulting in a pattern of high bear densities (reaching 5-11 inds./100 km²) in core mountain ranges such as Veľká Fatra, Malá Fatra, Nízke Tatry, Západné Tatry and Poľana, with much lower densities in low lying areas between, as well as in peripheral parts of the range, where there is less forest cover and human activity is more intensive.

According to expert estimates of bear numbers in Slovakia, since 1932 the West Carpathian sub-population has grown at an average rate of c.4.5%/year, or doubling of the population every 15-16 years, despite the recommencement of hunting in 1958-62. It is widely assumed that male-biased trophy hunting in the 1960-80s disrupted the age-sex structure of the population.

Harvesting bears >150 kg has been limited for the last 25 years.

In current Slovak legislation, the brown bear is both game and a protected species. A reservation has been made from the Bern Convention to allow hunting. There has been a downward trend in both legal harvest and all known mortality since 1992, whereas the population still seems to be growing. Since 2000, trophy hunters have shot 11-35 bears per year. The current level of hunting, though accounting for 72% of all known bear mortality in 1994-2006, is unlikely to cause population decline. In 1994-2006, c.4%/year of the estimated population was shot, suggesting that the maximum sustainable legal harvest is c.8.5%/year, equivalent to c.70 bears.

Loss, fragmentation and degradation of habitat could be more important threats to bears than legal hunting in the mid- to long-term. Measures to mitigate impacts of highways and other development have sometimes been insufficient. On average, 3.5 bears per year are killed by vehicles.

Most Slovaks think it is good there are bears in their country. Fear of attack, personal experience of damage, socio-demographic factors and knowledge levels all influence attitudes. Over three-quarters of survey respondents agree that hunting should be strictly regulated and almost as many think it should be banned in National Parks. Lack of information and problems with people were most often cited as important current issues.

Economic damage is inconsequential on a national scale: total annual compensation payments have rarely exceeded €28,500. Compensation has been paid for losses of livestock and beehives since 1962 and for other forms of damage since 2003-04. There is provision for the removal of individual problem bears.

2. ECOLOGY

2.1. Habitat

Brown bears need large, continuous areas of suitable habitat to support an interconnected viable population. The key components of bear habitat have been identified as food, escape cover and den sites (Swenson et al. 2000).

No quantitative studies of bear habitat selection or preference in Slovakia have been published. The available, anecdotal descriptions of habitat use are based on incidental observations and occasional monitoring. Observing current use locally leads to over-simplification. For example, Halák (1993) stated that, “*the habitat of bears is forest*”. In fact, the original, widespread distribution of the brown bear illustrates its ability to adapt to different environmental conditions. With little or no human interference, they occupied not only forests but also steppe as well as northern and alpine tundra. Human presence, habitat alteration and persecution have largely restricted bears to remaining forested areas (Swenson et al. 2000).

Slovakia has a relatively high level of forest cover, to which bear distribution

during the last 40 years has been closely correlated (Fig. 2.1). Forest cover is most extensive in upland areas with less human influence than neighbouring low-lying areas (Fig. 2.2). In total, c.41% of Slovakia is classified as forest land. Typical forest landscapes, unpopulated or only sparsely populated by humans, comprise 26% of the country, while mixed landscapes of forests, fields and meadows account for a further c.30% (Mindáš et al. 2006 p.115).

“*Optimum ecological conditions for brown bears*” in Slovakia have been described as natural coniferous and mixed coniferous-deciduous communities above 800 m a.s.l with beech (*Fagus sylvatica*), spruce (*Picea abies*), sycamore (*Acer pseudoplanatus*), rowan (*Sorbus aucuparia*) and dwarf pine (*Pinus mugo*) (Janík 1997 citing Nováková and Hanzl 1970). In the manual for a programme of care of Natura 2000 sites (Appendix VI) it is implicit that bear habitat is considered to be above 600 m a.s.l. Kováč (2003) regarded “*optimum occurrence*” (a term he did not define) in the Tatranský National Park to be at 1,200-1,600 m a.s.l.

Tab. 2.1. Dominant forest types by vegetation level in the West Carpathians (left section of table) and forest cover by altitude band in the Slovak Republic (right section). Source: Mindáš et al. 2006.

Dominant forest type by vegetation level				Proportion of forest cover by altitude band			
Veg. level	Dominant forest type	Distribution (m a.s.l.)	%	Altitude band (m a.s.l.)	% of SR	% forested	% of total forest cover
-	<i>Ulmeto-Fraxinetum</i>	-	2				
1	<i>Carpineto-Quercetum</i>	< 300	5	< 300	40	16.5	16.1
2	<i>Fageto-Quercetum</i>	200-500	15				
3	<i>Querceto-Fagetum</i>	300-700	24	301-800	45	56.1	61.8
4	<i>Fagetum typicum</i>	400-800	21				
5	<i>Abieto-Fagetum nst</i>	500-1,000	21	801-1,500	14	63.4	21.7
6	<i>Fageto-Abietum vst</i>	900-1,300	9				
7	<i>Sorbeto-Piceetum</i>	1,250-1,550	2				
8	<i>Mughetum acidophilum</i>	> 1,500	1	> 1,500	1	18.5	0.4

Fig. 2.1. Forest cover and confirmed occurrence of brown bears in Slovakia since 1963. Sources: forest cover from Mind'áš et al. 2006, bear distribution as for Fig. 1.1.

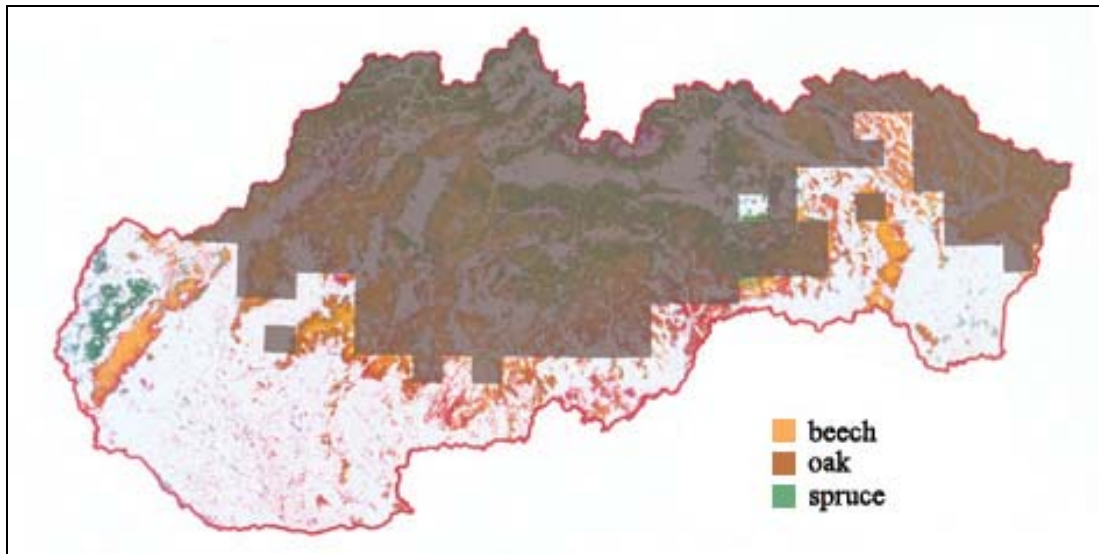
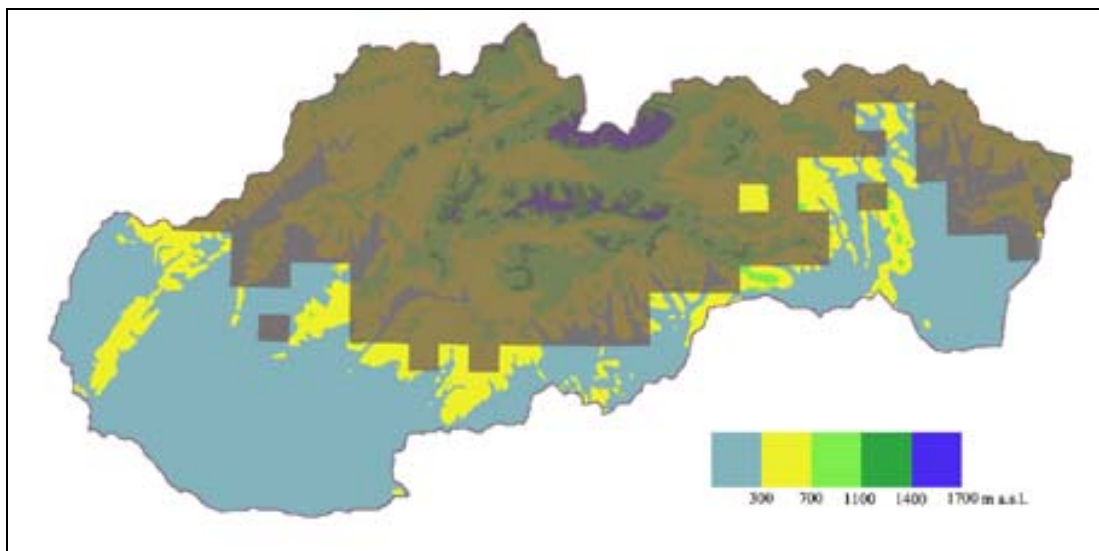


Fig. 2.2. Altitude zones and confirmed occurrence of brown bears in Slovakia since 1963. Sources: altitude zones redrawn from Danko et al. 2002, bear distribution as for Fig. 1.1.



From an ecological perspective, there is no reason to disregard forests at lower elevations. More than three quarters of Slovakia's forest cover is below 800 m a.s.l. (right section of Tab. 2.1). Historical documents show that in the 16th century there were bears in beech forests of northern Hungary (Teren 1987a). Forests dominated by oak (*Quercus petraea*) and/or beech below 800 m a.s.l. comprise 65% of forest land in Slovakia, compared to 30% for mixed deciduous-coniferous forests between 500 and 1,300 m a.s.l. and

just 3% for spruce and dwarf pine stands above 1,250 m a.s.l. (left section of Tab. 2.1). On a finer scale, bear habitats are not exclusively forests: they use, for example, sub-montane pastures, meadows and fields as well as sub-alpine and alpine meadows.

Food

Bears use a wide range of habitats for feeding, from alpine and sub-alpine meadows with extensive berry patches to sub-montane, partially deforested areas including arable fields (Rigg 2004a).

Concentrations of bears have been reported in areas of low human disturbance with high availability of natural food (Baláž 2002).

Bears are known to use different habitats during the year depending on food availability. In spring, bears need access to areas at lower elevations where plant growth begins early (Dečak et al. 2005). Bears in the Tatra Mountains descend from den sites near the upper timber line at c.1,500 m a.s.l. to sub-montane areas below 1,000 m a.s.l. where snow melts earlier and carcasses of winter-killed or wolf- or lynx-predated ungulates are often available (R. Rigg pers. obs.). In autumn, bears in Poľana move southwards into oak forests at lower elevations in order to feed on acorns (e.g. R. Rigg pers. obs.). Seasonal gathering of bears at substantial anthropogenic food sources, particularly fields of maize and other crops, is common (Rigg 2004a).

Reproductive success in bears is strongly correlated with food availability (reviewed in Herrero 1985 p.158-159). The continued growth of Slovakia's bear population would therefore suggest that the biological carrying capacity in terms of food availability of all habitats has not yet been reached. Suspected regional variation in average litter size (see 2.6) might also be related to food availability.

Escape cover

Bear distribution is not determined by food availability alone. Food availability may be good in open habitats, but bears prefer to take refuge in nearby forests during the day. In areas where bears are subject to hunting and poaching and there is a history of persecution, protective shrub or forest cover is likely to be an indispensable part of their home ranges, crucial for their survival (reviewed in Swenson et al. 2000). Bear distribution in Slovakia is closely correlated to forest distribution (Fig. 2.1), presumably largely due to the cover it provides. Bear

movements also seem to be closely linked to forest cover in Poland (Jakubiec 2001) and the Czech Republic (Bartošová 2003).

Topography may also be important, as steep slopes are associated with low human activity. Bears are rare or absent in some parts of Slovakia despite extensive beech-dominated forests, such as the interface between the West and East Carpathian sub-populations, possibly due to a lack of broken terrain providing refuge (Baláž 2003). Some experts believe that the need for forest and/or steep slopes may decline over time with reduced human persecution of bears (Swenson et al. 2000).

Den sites

Swenson et al. (2000) noted that den sites are often associated with remote areas with low human disturbance. Typically, bears do not reuse the same den but return to the same general area (Manchi and Swenson 2005). Concentrations of dens have been reported from many areas, such as Norway and European Russia, Spain, the Caucasus Mountains and Alaska. This is a pattern into which observations of denning bears in Slovakia also seem to fit. In Poľana, at least 18 different individuals, including females with cubs, subadults and large males, used a 25 km² area of dense forest with rock outcrops during winter 2006-07 (R. Rigg pers. obs.).

In the Tatra Mountains, Halák (1993) found that bears tended to hibernate in the sub-alpine zone of dwarf pine, particularly in limestone areas. Kováč (2003) stated that mainly alpine and sub-alpine areas are used for denning but also mentioned use of forest habitats, with dens in natural caves and holes, under large trees with branches reaching down to the ground, under uprooted trees, in hollow trees, in dense stands of old-growth forest and so on.

In areas without alpine areas or steep slopes, bears may hollow out dens among the roots of standing trees (R. Rigg pers. obs.). Teren (1987a) mentioned that dens have been found in dense stands of young

conifers. Some bears do not use a den and instead allow falling snow to cover them directly (Jakubiec 2001). Quantitative data on den types in the Carpathian Mountains are available from Poland (Jakubiec 2001).

2.2. Diet

Brown bears pass through 3 biochemical and physiological states during their active period, beginning with hypophagia (decreased food intake) in spring and ending with hyperphagia (increased food intake) in autumn. In late summer and early autumn it is very important for bears to consume food with high energy content in order to accumulate the fatty tissue necessary for hibernation (reviewed in Swenson et al. 2000).

In Slovakia, bear diet has been studied in detail only in the Tatra and Fatra regions of the north. In 2001-03 it was found that plant material constituted c.91% of total scat volume and c.84% of dry matter consumed (Rigg 2004a, Rigg and Gorman 2006a). Grasses/sedges and herbs dominated in spring and early summer, with a shift to fruits (*Vaccinium myrtillus*, *Rubus idaeus*, *Vaccinium vitis-idaea*, *Sorbus aucuparia*) in July-October.

Animal material comprised c.8% of total scat volume and c.15% of dry matter consumed. Although predation on sheep and cattle was known to have occurred in the study area (Rigg and Gorman 2006b), no remains of livestock were identified in any of 373 bear scats analysed, indicating that livestock is not a major component of the diet. Juvenile Cervidae and wild boar were identified in scats from May-July, some of them probably obtained by predation. In early spring bears scavenged on carcasses of predated or winter-killed ungulates. The total proportion of wild ungulates in the diet was estimated as 6% of dry matter consumed. Insects (mostly ants and wasps) occurred significantly more frequently and in greater quantities than large mammals (Rigg 2004a, Rigg and Gorman 2006a). Insects are rich in

protein and a source of essential amino acids (Swenson et al. 2000).

All anthropogenic food items combined were estimated to account for at least 23% of total scat volume and c.40% or more of dry matter consumed (Rigg 2004a, Rigg and Gorman 2006a). Refuse was found in c.7% of scats, significantly more frequently in spring than in any other season. Use of anthropogenic food was least in June-August, when bears fed mainly on green vegetation, berries and Formicoidea. Fruit, mast and wasps were important food sources in September-November. However, overall autumnal diet of bears in the study area was found to be dominated by cultivated grains, obtained at hunters' ungulate feeding sites and in fields as pre-harvest crops.

As well as among seasons, food availability and hence bear diet can differ among localities and years. In addition, differences have been observed among age-sex classes. For example, female bears may consume greater quantities of insects than males whereas adult males are generally the most predatory (reviewed in Swenson et al. 2000).

Although there is some competition and occasional aggressive encounters, bears probably benefit from the presence of wolves, increasing their protein intake from ungulate carcasses (Ballard et al. 2003). Bears scavenging on wolf kills or depriving them of their prey accounted for 67% of 18 interactions between the two species recorded in the Polish Carpathians (Jakubiec 2001).

2.3. Hibernation

Depending on location (latitude) and if they have formed sufficient fat reserves, brown bears become lethargic in late autumn and hibernate, although some individuals, especially in southern populations, may stay active throughout the year. The use of dens is probably an adaptation to limited food availability

during the winter and perhaps also to giving birth to fragile cubs unable to maintain their own thermoregulation (Swenson et al. 2000). The mechanisms of denning behaviour are not well understood but it is probably controlled by interaction of several stimuli including decreased food availability, low temperatures, snow fall, physical conditions and the sex, age and reproductive status of bears. Movement rates decline in advance of denning, particularly in the last 2 weeks (Manchi and Swenson 2005).

In the Western Tatras in 1977-86, the average interval between last observed bear activity at the beginning of winter and the first signs of activity at the end of winter was approximately 97 days, with a range from 73 to 113 days (Halák 1993). The date of observing the last tracks varied from 4.11 to 31.12. In Poland, equivalent dates were 22.11 to 6.12 (Jakubiec 2001). In Sweden, date of den entry was closely related to first snow fall. Pregnant females entered their dens first and males last. Large males can store more fat and lose less energy due to their small surface area to volume ratio, so can remain active longer (Manchi and Swenson 2005).

The date when the first signs of bear activity at the end of winter were found by Halák (1993) in the Tatras varied from 15.2 to 11.4. According to this author, if weather conditions were not exceptional, in winters when bears went into their dens later they generally seemed to emerge later. However, this conclusion is contradicted by results from Scandinavia, where no relationship was observed between date of emergence and presence of snow in spring, suggesting that spring emergence may be stimulated by day-length or temperature (Friebe et al. 2001, Manchi and Swenson 2005). In Slovakia, the winter of 2005-06 was long and cold with much snow whereas that of 2006-07 was short and mild with less snow, but in both cases the first tracks of bears in the

Western Tatras appeared in the second half of February (R. Rigg pers. obs.).

Females with new cubs leave their dens much later than other bears. Halák (1993) estimated the difference as 3-4 weeks; Kováč (2003) stated that in the Tatras females with cubs do not emerge until the second half of April or early May. However, Rigg (2004a) found tracks of females with cubs on 30.3.2002, 31.3.2002 and 5.4.2001. In Poland, where most bears leave their dens in early March, the delay between the emergence of lone bears and females with cubs has been estimated as at least 12 days (Jakubiec 2001). In Sweden, radio-collared pregnant females spent on average 1 month longer in or at their dens compared to solitary females, females with older cubs, subadult females and males. Males emerged an average of 17 days earlier than females. Duration of denning decreased with age and body mass in males but increased in females (Friebe et al. 2001, Manchi and Swenson 2005).

If temperatures are high and/or food is available, bears may not hibernate. In the mild winter of 1982-83 some bears in central Slovakia were active throughout January (Pelikán 1983), as were some in the east in 2006-07 (K. Sooš pers. comm.). Intensive feeding by hunters (Hell and Slamečka 1999 p.34) and a good crop of rowan berries (Baláž 2002) have resulted in active bears. SNC records show that a 10-15 year old male shot in Turčianske Teplice district on 8.3.1991 had been active all winter, feeding on food left by hunters for red deer. According to Halák (1993), bears may wake and become active during the winter not only when the temperature rises but also if it drops considerably. He mentioned bears in the Tatras emerging from their dens and feeding on rose hips (*Rosa canina*) from 15.12.1984 to 5.1.1985, when night-time temperatures were $> 0^{\circ}\text{C}$, and also from 6.1. to 10.1.1987, when temperatures were between -17°C and -28°C .

Baláž (2003) noted that bears are often subject to disturbance by people in some parts of the range, especially if commercial management has changed the forest structure and gentle topography allows greater access than in mountainous areas with steeper, rocky slopes. Disturbance of denning bears can have serious consequences, including higher energy use due to more movement in the den, den and cub abandonment, increased cub mortality and displacement from denning areas (Swenson et al. 1997b, 2000, Linnell et al. 2000, Podruzny et al. 2002). In Sweden, most documented den abandonment occurred before mid-winter; at least 67% of cases were apparently due to human disturbance (Swenson et al. 1997b).

2.4. Home range

Bears, like all large carnivores, have large home ranges. However, home range size varies greatly throughout the range, apparently in relation to habitat productivity. Generally, bear home range size depends on food availability and distribution, as well as population density, and is greatest in the north of Europe and lowest in the south (Swenson et al. 2000). In Scandinavia, home range size of subadults was found to be related to the size, not the age, of individuals (Dahle et al. 2006b). Home range sizes of both adults (Dahle and Swenson 2003c) and subadults (Dahle et al. 2006b) decreased with increasing population density, more so in males than females.

In Slovakia, home range size has commonly been estimated by dividing the size of a given area by the number of individual bears observed within it. This is in fact a density estimate because it makes the assumption that home ranges (even those of a female and her cubs) do not overlap, which is incorrect (see below). Nevertheless, this type of calculation has been widely used in important discussions and documents. For example, in materials prepared for the Commission for Large

Carnivores and approved by an expert group at Zvolen Technical University, an estimate is given of 1 ind./9.8-13.0 km², which is referred to as both population density and home range as if these were synonymous, which they are not.

Brown bear home ranges often overlap considerably (Huber and Roth 1993, Swenson et al. 2000). Home range size therefore tends to be larger than density estimates suggest and is likely to have been substantially underestimated by Slovak authors, who have typically given estimates of 10-30 km² (e.g. Sabadoš and Šimiak 1981, Hell and Slamečka 1999). Baláž (2002) used the distribution and height of bite marks on trees (Jamnický 1987) to estimate home ranges of 17-20 km² for 2 “territorial” males. This method has several problems, including the dubious assumptions that all bite marks are found and that bears leave bite marks in all areas they use or move through. Bite marks appear to be left on trees mainly from April to July and therefore probably do not indicate the total home range used throughout the year.

Telemetry is undoubtedly the best method available to obtain data on home range and many other parameters. Its use in other European countries has led to much larger estimates than those of Slovak authors, especially for males. A radio-collared male and female studied by Polish researchers in the Tatra Mountains were found to have home ranges of 170 km² (in 2004) and 136 km² (in 2000-03), respectively, both of them partially on the Slovak side of the border (Zięba and Kozica 2005). A very large adult male in Bieszczady NP, in south-east Poland bordering Slovakia, used an area of 266 km² in one year. Exceptionally, an individual in the Sudety Mountains was known to have used a total area of 1,220 km² in 7.5 years (Jakubiec 2001).

An instructive comparison can be made with data from Croatia, where telemetry research on bears began in 1981 (Huber

and Roth 1993). Fourteen radio-collared bears were known to use an area of 736 km², equivalent to a mean home range of c.53 km²/bear (excluding additional individuals not radio-collared) if home ranges were not over-lapping. However, radio-telemetry showed that home ranges did over-lap. Four bears for which at least 17 daily locations were obtained used areas of 97-224 km² (minimum convex polygon). The mean home ranges recorded for 4 males and 5 females in Croatia were 128 km² (max. = 224 km²) and 58 km² (max. = 147 km²) respectively. The home ranges of males may have been even larger because they were harder to relocate. In Croatia, it has been estimated that a bear uses an area of c.250 km² during its lifetime (Dečak et al. 2005).

2.5. Activity

According to Litvaitis et al. (1996), the distributions of food and cover are likely to most influence an animal's movements within its home range, although there may be other factors operating, such as avoidance of competition.

Bear movements and habitat use, as well as reproduction and survival of bears, are strongly affected by availability of food. Areas with a high availability of preferred foods, such as berries, fruits, hard mast, colonial Hymenoptera and ungulates, are of special importance for brown bears (Swenson et al. 2000). Herrero (1985) stated that seeking and eating food are the main motivators influencing the movements and locations of both brown and black bears in North America.

The movements and activity patterns of sloth bears (*Melursus ursinus*) in fragmented habitats in India have been found to be governed by phenological patterns of food plants, crop stages, food availability and disturbance factors as well as livestock grazing (Chauhan 2002). Knowledge of home range, movements and activity patterns therefore gives insights into a species' habitat

requirements as well as relations with humans and human activities, which can be used to prioritise areas for conservation (cf. Peralvo and Cuesta 2002).

Although some authors have published anecdotal evidence or descriptive accounts (e.g. Halák 1993, Baláž 2002), no quantitative studies of bear activity patterns have been conducted in Slovakia.

Brown bears may be active during the day as well as at night, depending on habitat conditions, availability of food and human activity. Constant disruption by human activities caused most European bears to switch to a secluded nocturnal life, which is not the case in Siberia or North America (Swenson et al. 2000). MacHutchon (2001) noted that brown bear activity budgets are highly variable geographically, seasonally and both among and within individuals, and may be influenced by individual traits (age, sex, weight, reproductive status, physiology) as well as environmental factors (weather, thermal stress, lunar phase, predation, seasonal food type/abundance, available daylight and human disturbance). In areas of low human use, bears are generally most active during the day and least active at night. In the Slovak Carpathians, bears seem to be mostly night-active in areas of high human use but are also active during daylight hours in areas of lower human use (R. Rigg pers. obs.).

Movements and distribution tend to show certain seasonal patterns dependent particularly on the changing availability of various food sources. In spring bears often move from their den sites down into valleys to feed on fruit from the previous year, visit hunters' game feeding sites and search for carcasses of ungulates that died at the end of winter or were killed by wolves or lynx (Jamnický 1988b, Halák 1993, Rigg 2004a). In summer and autumn, some bears travel from the upper timberline at c.1,500 m a.s.l. to feed on cereal crops below 900 m a.s.l. (Halák 1993, Rigg 2004a).

Telemetry research in other European countries has produced much more precise and detailed results. The median and maximum straight-line distances between consecutive day locations for radio-marked bears in Croatia were 1.5 km and 8.5 km respectively. Average daily movements of males and females were similar, but females tended to confine theirs within a smaller area (Huber and Roth 1993). Bears typically moved to lower elevations with more open space (closer to humans) to seek food at night and retreated to quieter, more densely vegetated areas during the day (Dečak et al. 2005). Some bears in Romania travelled 15-17 km or more to feeding sites and refuse bins (Weber 1987, Mertens and Sandor 2000).

2.6. Reproduction and survival

The reproductive biology of bears in Slovakia has not been well studied but there is no reason to suppose that it does not fit general patterns observed elsewhere and reviewed in Swenson et al. (2000).

Mating occurs in mid-May to early July. The brown bear is a polygamous species: not only do males try to mate with more than one female, but multiple fatherhood in a single litter has also been recorded. Female promiscuity may be an adaptive strategy to avoid cub loss due to sexually selected infanticide by males, which may itself be an adaptive mating strategy for males to increase breeding opportunities (Bellemain et al. 2006). There is some evidence from Scandinavia of reproductive suppression in young females, possibly due to resource competition within female hierarchies (Støen et al. 2006).

After fertilisation, the embryo develops until the blastocyst stage but then its development stops until implantation in the uterus in late November. The female gives birth in January to 1-4 (rarely 5) cubs, usually once every 2-3 years. The average birth weight of cubs is c.0.5 kg (Swenson et al. 2000).

The mean litter size of 48 females with cubs <1 year observed across Slovakia's bear range in 1977 was 2.3 (Sabadoš and Šimiak 1981). In 1992, 57 females with cubs of the year had an average of 1.7 cubs, with a range of 1-3 and mode of 2 (Hell and Sabadoš 1995). In the Polish Carpathians, observed litter size in 1980-1999 averaged 1.5 with a mode of 1 (Jakubiec 2001 p.46). These are regarded as minimum estimates because some cubs may have been missed or already died before observations were made.

Only 5% of 57 females observed with cubs in 1992 had 3 cubs and none had 4 cubs. There may be local variation (Tab. 2.2). Baláž (2002, 2003) reported that 3 out of 6 (50%) of females with cubs of the year he observed in Západné Tatry had 3 cubs. Halák (1993), who also worked in this mountain range, described seeing a female with 3 cubs in 1984 and Lenko (2006) has recently reported the sighting there of a female with 4 cubs of the year. Hell and Sabadoš (1995) mentioned that they knew of cases of females with 4 cubs, as did Kováč (2003).

Tab. 2.2. Observed litter sizes of two local communities of bears in comparison to a range-wide census. Sources: Hell and Sabadoš 1995 (range-wide census), Baláž 2002, 2003 (Západné Tatry), Pčola 2003 (Poloniny).

<i>Litter size:</i>	% of females with cubs of the year			<i>Mean (n)</i>
	<i>1</i>	<i>2</i>	<i>3</i>	
Poloniny	50%	50%		1.5 (4)
Záp. Tatry		50%	50%	2.5 (6)
range-wide census	37%	58%	5%	1.7 (57)

For comparison, over 60% of litters observed in Ukraine (Slobodjan 1979 cited in Jakubiec 2001) and 54% in Croatia (Frković et al. 2001) had 2 cubs of the

year. Five out of 6 estimates of average litter size given in Danilov (1994) for regions of northwest Russia and Estonia were higher than 1.7 (range 1.65-2.23). Average litter size in North America is rarely less than 2 (reviewed in Palomero et al. 1997). The mean litter size observed for cubs of the year in Croatia, where 7% of litters had 4 cubs, was 2.4 (Frković et al. 2001). In Estonia, 2% of litters had 4 or even 5 cubs (Valdmann et al. 2001).

If the decrease in observed litter size in Slovakia from 2.3 in 1977 (Sabadoš and Šimiak 1981) to 1.7 in 1992 (Hell and Sabadoš 1995) is reflective of a real change, rather than of study design or sampling error, it could be a density-dependent effect. Interestingly, average litter size in Slovenia's expanding bear population gradually increased from 1.0 in 1946-59 to 2.0 in 1990-92 (Adamič 1997). Likewise in Poland the observed average litter size increased during the period 1980-1999 (data in Jakubiec 2001 p.46).

Hell and Sabadoš (1995) suggested that the relatively low average size of litters seen in the West Carpathians in 1992 may have been due to a preponderance of young females in the population as a result of trophy hunting; according to these authors, young females tend to have 1-2 cubs. Teren (1987a) also noted that young as well as old females often have only 1 cub. Most authors internationally relate litter size to food availability, though it has been suggested that small litter size in small populations might be due to genetic problems and/or aging females (reviewed in Palomero et al. 1997).

Based on a sample of 6 litters, Baláž (2002, 2003) concluded that average cub mortality in Západné Tatry between spring of the first year of life and autumn of the second is 40%. For 2 litters of 4 cubs seen by Lenko (2006) in the same area, the equivalent figure was 0 and 50%. Jakubiec (2001) stated that mortality in the first few months of life can be up to 50%. Studies elsewhere have reported figures ranging

from, for example, 2% in northern Sweden to 35% at McNeil River in Alaska (reviewed in Frković et al. 2001). Survival of subadults in Sweden increased with increasing body size as yearlings, which was positively related to maternal size and negatively related to litter size and population density (Dahle et al. 2006a).

Length of maternal care in brown bears varies both among and within individuals. Generally most European brown bears are weaned as yearlings (Dahle and Swenson 2003a). In northern Sweden, young bears were observed to become independent with body masses of 17.5-69 kg. Around half the observed litters were nursed for 1.5 years, half for 2.5 years and 1 out of 38 litters (3%) for 3.5 years. Yearlings of lower body mass were more likely to stay with their mother for a second year, as were litters of 2 cubs compared to those of 1, 3 or 4 cubs (Dahle and Swenson 2003a).

Observations of 2 year-old cubs with their mothers seem to be less common in more southerly populations, where yearlings tend to be heavier than in northern European populations (Frković et al. 2001, Dahle and Swenson 2003a). The break-up of bear families typically occurs during the mating season in May-July and tends to be associated with the presence of an adult male (Dahle and Swenson 2003b). However, there are frequent reports from Slovakia of females seen together with young of different ages.

Onset of sexual activity is relatively late in brown bears: usually after the fourth year of life (Schwartz et al. 2003), although there is evidence of 3-year-old females giving birth in Croatia (1 case; Frković et al. 2001) and Austria (2 cases; Zedrosser et al. 2004). According to Hell and Slamečka (1999), females in Slovakia usually come into heat for the first time at the age of 3.5 years and give birth to their first cubs at 4 years of age, but mating of 2.5 year-olds is said to have been seen. The authors did not state how these data were obtained.

Female brown bears seem to be most productive at 8-9 years old; productivity is relatively high until c.25 and reproductive senescence occurs at c.27 years of age (Schwartz et al. 2003).

For those individuals surviving to adulthood, the brown bear is characterised by a relatively long lifespan. The oldest of 279 bears killed in 1966-88 and aged by Sládek (1991) came from Tatranský National Park and was estimated to be 33-35 years old. Presumably an individual is more likely to survive to old age if it spends most of its time in protected areas where there is no legal hunting, less disturbance and less risk of conflict with humans. This could explain why large old bears tend to be found in the best habitats.

2.7. Social organisation, dispersal

The social organisation of bears is very poorly known, but the relationship between individuals, particularly adults, greatly depends on available space and reciprocal avoidance, except in the mating season (reviewed in Swenson et al. 2000).

In the absence of substantial telemetry or genetics studies, few details are known about social organisation and dispersal in Slovakia. It is widely believed within Slovakia that dominant males occupy the best habitat and mark "*territories*" with bite marks on trees in order to "*displace*" subordinate bears into lower quality habitat. However, more rigorous study elsewhere indicates that it is far from clear to what extent brown bears are territorial. Their home ranges typically overlap those of other individuals and congregations of several bears at sources of abundant food are not unusual. Overlapping of activity ranges of individual bears is less well understood in high density southern populations than in northern Europe, but it has been documented by radio-telemetry studies in Croatia (Huber and Roth 1993), Romania (Mertens and Sandor 2000) and Poland (Zięba and Kozica 2005).

The hypothesis that dominant old males displace subordinate bears, thus causing subadults to come into closer contact with humans and develop nuisance behaviour, is not consistent with some other observations: use of anthropogenic food sources, especially refuse, is not highest during the period when most tree-marking is done (Rigg 2004a); young bears are present during the breeding season within areas heavily tree-marked (R. Rigg pers. obs.); local concentration of females with cubs has been observed within an area also used by several very large males (Baláž 2002, 2003).

Bite marks appear to be left on trees mainly from April to July (especially in May-June), which suggests they may be related to breeding activity (Teren 1987a), although this is also the time when sap is rising (Jamnický 1976, 1987) and brown bears moult (Macdonald and Barrett 1993 p.105). Bears seem to mark important places, such as travel routes, feeding sites and where changes have occurred (Jamnický 1987, Z. Jakubiec pers. comm.).

Killing and consumption of cubs by adult, presumably male, bears has been recorded in Slovakia (Fig. 1.10) and Poland (F. Zięba pers. comm.). Intraspecific killing is relatively common in brown bears. Adult males most often do the killing, and cubs are most often killed, but females also kill cubs and males are known to kill all age and sex classes, including adult females (McLellan 2005). Some of this killing is predatory but some may be sexually selected (see Swenson et al. 1997a, 2001a,b, Miller et al. 2003).

Whether or not males exclude other bears from their home ranges and to what extent they are territorial has not been established definitively even by extensive telemetry and genetic research studies (e.g. Mueller et al. 2004). Although it does seem to be mostly male bears that leave marks, non-invasive genetic research has shown that approximately one third of hair samples collected at rub trees in the

Northern Rocky Mountains came from female brown bears (Kendall et al. 2005). Tree rubbing by female brown bears has also been recorded in Japan, where most tree rubbing by males was done not by resident individuals but by immigrants (Sato et al. 2005).

An alternative hypothesis to explain the tendency of older bears to be found in the best habitat and younger individuals in peripheral areas is differential mortality rates between the two, i.e. bears are more likely to be killed by hunters, hit by vehicles or removed as nuisance bears in peripheral habitats and so the average age there is lower compared to core areas. In Croatia and Slovenia, bears killed in collisions with vehicles are most often young, probably dispersing males (Huber et al. 1998, Dečak et al. 2005, Jerina et al. 2005). In Slovakia, bears killed in vehicle collisions as well as those shot as nuisance bears also tend to be young (Fig. 1.13).

It has been demonstrated in Scandinavia that whereas young males disperse long distances (up to 467 km), females remain in their mother's home range or its immediate vicinity, usually dispersing about 25 km (Støen et al. 2005). Subadult males spent their first winter alone close to the mother's denning area then moved long distances before the next denning (Manchi and Swenson 2005). Dispersal in Scandinavia seemed to begin before habitats were saturated with bears (Swenson et al. 1998b). On the other hand, in Slovenia the rate of dispersal was found to be inversely correlated to harvest rate in the core area (Jerina and Adamic 2002).

2.8. Parasites, diseases, pollutants

Of 24 dead bears examined for helminths during the period 1954-70, 21 (88%) were host to one or more species (Mituch 1972). A total of 5 species were found: *Aelurostrongylus abstrusus*, *Taenia hydatigena*, *Thominx aerophilus*,

Toxascaris transfuga and *Trichinella spiralis*.

Of 91 bear scats collected in 2002-03 and examined for endoparasites, 43 (47%) contained one or more species (Goldová et al. 2003). The following were identified: *Baylisascaris* spp. (14%), *Cryptosporidium* spp. (7%), *Toxascaris transfuga* (5%), *Ancylostoma* spp. (2%), *Capillaria* spp. (1%) and *Taenia* spp. (1%).

Ursíny et al. (1970 cited in Sabadoš and Šimiak 1981) reported one case of a bear in Slovakia found to have been infected with rabies. Kadlečík (1983), writing about Veľká Fatra, mentioned a case in which a bear had contracted rabies after feeding from a carcass, left by hunters, on which a fox (*Vulpes vulpes*) had previously fed.

Mycobacterium avium subspecies *paratuberculosis*, the causative agent of paratuberculosis in ruminants, has been isolated from the intestinal mucosa of 2 brown bears killed in Nízke Tatry NP (Kopečna et al. 2006).

As an omnivore and top predator, the brown bear is especially susceptible to contamination by heavy metals from industry. Toxic emissions have been decreasing in Slovakia since 1990, but whereas the concentrations of cadmium in the muscles and liver (but not the kidneys) of shot bears were lower in 2002-04 (Čelechovská et al. 2006) than in 1988-90 (Žilínčár et al. 1992), those of lead and copper were not significantly different and levels of mercury in the liver, kidney and muscles were higher.

The highest heavy metal concentrations tended to be in the kidneys. Strong correlations were found between mercury content and body weight of bears and between copper concentration and age, reflecting a gradual accumulation of contaminants in tissues (Čelechovská et al. 2006).

Summary and evaluation of ecology

The chapter on ecology is necessarily short because there has been very little robust research done on bear ecology in Slovakia.

The only results of radio-tracking so far available are from bears caught, collared and monitored by Polish researchers. Their estimates of home range size in cross-border areas were 170 km² and 266 km² for 2 males and 136 km² for a female.

Bear distribution is closely correlated to forest cover, which is most extensive in areas with relatively low human settlement above 300 m a.s.l. The highest densities are in protected mountain areas with extensive mixed, deciduous or coniferous forests. Pastures, fields and sub-alpine meadows are also commonly used habitats.

Habitat use shows seasonal patterns related to changing availability of various food sources. In spring, many bears move from den sites in less accessible locations down into sub-montane areas to feed on fruit from the previous year, visit hunters' game feeding sites and search for ungulate carcasses. In summer and autumn, bears in the Tatra and Fatra Mountains often travel between berry patches above the upper timberline at c.1,500 m a.s.l. and cereal crops below 900 m a.s.l. These movements are distinct from the dispersal of subadults out of their mother's home range.

It is widely believed in Slovakia that dominant males occupy the best habitats and mark "territories" with bite marks on trees in order to "displace" subordinate bears into lower quality habitat. However, no data supporting this assertion have been published. Researchers in other European countries and elsewhere have found that home ranges typically overlap and congregations of several bears at sources of abundant food are not unusual. A tendency for large old bears to be in better habitat could also be explained by differential survival rates: presumably an

individual is more likely to survive to old age if it spends most of its time in protected areas where there is no legal hunting, less disturbance and little likelihood of being hit by a vehicle. Individuals that do not cause damage or otherwise become involved in conflicts with humans are presumably also likely to survive longer.

Bite marks appear to be left on trees mainly from April to July (especially in May-June), which suggests they may be related to breeding activity. Bears seem to mark important places, such as travel routes, feeding sites and where changes have occurred.

Plant material has been found to constitute c.84-91% of the diet in northern Slovakia. Grasses/sedges and herbs dominate in spring and early summer, with a shift to fruits (*Vaccinium myrtillus*, *Rubus idaeus*, *Vaccinium vitis-idaea*, *Sorbus aucuparia*) from July to October. The total proportion of wild ungulates (Cervidae and wild boar) in the diet is c.6%, consumed as carrion in spring with some predation on juveniles likely in May-July. Invertebrates (mainly ants and wasps) are consumed more than vertebrates. The autumnal diet is dominated by cultivated grains (mainly maize, oats and wheat), obtained at hunters' ungulate feeding sites and in fields as pre-harvest crops.

In the Tatra Mountains, bears usually den for c.2.5-3.5 months, from November-December to February-March (late March or April for females with cubs of the year). In warmer areas, in mild winters or if ample food is available, some individuals may remain active throughout winter.

The average litter size in the West Carpathian sub-population in 1992 was estimated as 1.7, which is quite small for the brown bear, although there seems to be geographic variation within Slovakia.

3. MANAGEMENT

3.1. Responsible authorities

State bodies

Bears are managed largely at state level in Slovakia. During the Communist period this was dominated by the State Forestry Service operating under the jurisdiction of the Agriculture Ministry or their equivalent predecessors. Since the 1990s, responsibility has been more shared between these bodies and the Environment Ministry with its associated organisations and authorities, primarily the State Nature Conservancy.

A 16-member Commission for Large Carnivores was established in February 2001 under the auspices of both the Environment Ministry and the Agriculture Ministry and given the task of drafting national management plans (Pilinský 2001b). It stopped meeting after a year having failed to find consensus, especially in regards to hunting, but may be reconvened. There have been signs recently of a warming of relations between state nature conservationists and forestry/hunting managers, including greater willingness to co-operate in order to find compromises acceptable to both.

NGOs

The short-lived Commission for Large Carnivores included 3 representatives of non-government organisations (NGOs): an environmentalist group, the Slovak Hunting Union and the Association of Sheep Breeders.

In 2002, NGOs organised a conference on nuisance bears (Rigg and Baleková 2003), attended by many significant figures in bear research and management in Slovakia and neighbouring countries.

In March 2006, for the first time, an environmentalist attended the annual bear management planning meeting.

Some radical environmentalist NGOs, notably the Wolf Forest Protection Movement, Freedom for Animals and Predator, remain staunchly opposed to hunting. The Slovak Wildlife Society has adopted policies closer to those of the SNC and the consensus of leading international experts, recognising that progress probably requires compromise.

Public participation

Favourable public opinion is important for successful management. The more the needs and interests of those affected by bears and their presence are considered when taking decisions, the more successful management is likely to be (Knapp 2006).

Slovakia became a democracy with the fall of Communism in 1989. Public consultation in decision-making still tends to be limited. Regarding the management of large carnivores, public involvement is apparently viewed in terms of a need for education (cf. Adamec et al. 2005) more than facilitating the participation of local community representatives in informed decision-making.

International co-operation

The international community has recognised for some time that where wildlife populations are shared between countries, transboundary management is highly desirable (Bath 2005). Since 2001, at the request of the Czech Environment Ministry, it has been a management goal to support natural dispersal of bears from Slovakia into the eastern Czech Republic by not allowing hunting in northwest Slovakia. However, Slovakia's most important borders in terms of large carnivore conservation and management are those with Poland and Ukraine, and yet there seems to have been very little collaboration with authorities in either of these countries (Knapp 2006).

3.2. Conservation action plans

Global

In its *Status Survey and Conservation Action Plan* (Servheen et al. 1999), the IUCN made several recommendations for conservation of bears in Slovakia (Hell and Find'o 1999). These are listed in Appendix I, which also includes an assessment of the extent to which they have been implemented.

European

Developing on the IUCN action plan, WWF, the LCIE and Council of Europe developed a pan-European action plan for brown bear conservation (Swenson et al. 2000). The overall goal of this plan, which was adopted by the Bern Convention, is *"to maintain and restore, in coexistence with people, viable populations of brown bears as an integral part of ecosystems and landscapes across Europe."* Two of the three objectives identified to reach this goal are relevant to Slovakia:-

- *Objective 1. To conserve the present viable brown bear populations in Europe and allow them to expand into suitable habitat, thereby increasing their population numbers and range to the limit that can be sustained given socio-economic realities.*
- *Objective 3. To reduce the conflict between brown bears and humans and promote activities that secure a positive public attitude towards brown bears.*

The specific actions required in Slovakia as identified in the action plan are listed in Appendix II, together with an assessment of the extent to which they have been implemented.

Carpathian

Preparation work for a Carpathian large carnivore conservation and management plan has been conducted by the Carpathian Ecoregion Initiative. The CERI was launched in 1999 (as CEI), facilitated by the WWF International Danube-

Carpathian Programme. It has placed an emphasis on large carnivores as *"flagship"* species and identified the brown bear as one of its *"focal species"*.

WWF has included the Carpathian Mountains among its priority *"Global 200"* ecoregions. CERI produced a CD-ROM on the *Status of the Carpathians*, which included a report on the *Status of Carnivores in the Carpathian Ecoregion* (Okarma et al. 2000), and a *Carpathian List of Endangered Species* (Witkowski et al. 2003). This list assessed the general population trend of the brown bear in the region as *"either stable or slightly increasing"*. The bear was classified as *"present but not threatened"* in Slovakia and Romania although *"endangered"* in the Carpathian countries overall.

The Council of Europe organised a Carpathian Workshop on Large Carnivore Conservation in Poiana-Brasov, Romania in June 2003. One of the aims of this meeting was to begin elaborating a Carpathian action plan for large carnivores. In the same year the Standing Committee of the Bern Convention adopted Recommendation No. 100, recommending the Carpathian countries to jointly prepare a Carpathian Strategy Plan for conservation and management of large carnivores. The plan, yet to be completed, is intended to be based on population, scientific and ecoregion approaches and is considered an important element in implementing the Carpathian Convention.

National

One of the main recommendations of the Council of Europe's action plan for the brown bear in Europe was for each range state to establish a management plan. Recommendation No. 100 (2003) on conservation of large carnivores in the Carpathians, adopted by the Standing Committee of the Bern Convention in 2003, recommended Slovakia and the other Carpathian countries to implement national action plans for large carnivores.

The Commission for Large Carnivores established in Slovakia in 2001 was given the task of drafting national management plans. However, largely due to disagreement between advocates of hunting versus those of strict protection, the committee soon became dysfunctional and stopped meeting without completing the management plans. It appears that the SNC intends to complete a bear management plan by 2007 and to implement it from 2008 (Knapp 2006).

Despite the continued lack of formal, single-document management plans for large carnivores, many of the elements required for such plans have already been enacted by various pieces of legislation, regulations and policy documents. This is particularly so for the brown bear. The main aims of the SNC in managing Slovakia's bear population have been stated as follows:-

- *Long-term sustainable development of the brown bear population in Slovakia;*
- *Preservation of the population's natural sex and age structure;*
- *Preferential protection of brown bears in protected areas;*
- *Concentration of hunting to locations with high and repeated damage to livestock and beehives and killing of human habituated bears preferred;*
- *Preference given to hunting nuisance bears and those in undesirable habitats;*
- *Creation of conditions for connection of the East and West Carpathian sub-populations of brown bears.*

(Kassa 2003, 2005, Adamec et al. 2005)

Very little scientific research has been conducted on the ecology of bears (and other large carnivores) in Slovakia and so in many instances managers lack data on which to formulate and justify their decisions and policies. However, in recent years a precautionary approach has been adopted. For example, while Knapp (2006)

is correct to state that hunting statistics are based on the sum of bears counted in each hunting ground and do not eliminate multiple-counting of the same individuals, and that scientists and NGOs have criticised these official figures as being over-estimates, these are not the figures on which hunting management is based. When quotas are set, 700-750 individuals (c.45-60% of the "official" figures) is considered a reasonable "guesstimate" of the number of bears in Slovakia.

3.3. Habitat protection

3.3.1. Protected areas

The bear population was able to recover thanks to an abundance of suitable habitat. Ensuring continued availability of habitat is of paramount importance. Protection of habitat specifically for bears was first proposed in Slovakia by A. Randík in 1965 (Martínková and Zahradníková 2003), although large protected areas were already in existence. The first National Park was established in 1948/49 while small reserves, some protecting fragments of old growth forest, had been declared from the late 19th century onwards.

The first expert organisation and law on nature conservation in Slovakia came into being in 1951 and 1955 respectively. Many protected areas were declared within a concept strategy approved in 1976-81 (Kramárik 1995). Two National Parks and a Protected Landscape Area within permanent bear range and a third National Park at the edge of the current range are also classified as UNESCO Man and Biosphere Reserves.¹² There have been many changes in organisational structure and jurisdiction, which inevitably must have affected efficiency and effectiveness.

Under the current system of area protection defined by the Nature and

¹² <http://www.unesco.org/mab/index.shtml>

Landscape Protection Act (no. 543/2002), all land is automatically given at least the first level of protection, which restricts some activities affecting habitats such as wetlands, river beds and woodlands. National Park buffer zones and Protected Landscape Areas are given the second level of protection, limiting a range of additional activities such as mining, road building, livestock grazing and fence construction. The third level of protection applies in National Parks and precludes the collection of forest fruits (except by land owners), hiking off marked tourist routes, camping outside designated areas, low-level flying and the use of chemicals in forestry and agriculture. The fourth and fifth protection levels are stricter but usually apply to small areas such as Nature Reserves and National Nature Reserves.

At present, approximately 23% of the total area of Slovakia has the second level of protection or higher. The vast majority of this is accounted for by National Parks, their buffer zones and Protected Landscape Areas (Fig. 3.1, Tab. 3.1). All smaller protected areas combined, some of them lying within larger protected areas but having higher levels of protection, cover 2.1% of Slovakia (SMOPAJ 2006). Over 80% of the total protected area is forest land (MP SR 2005). At least 7 of the 9 National Parks now in existence have permanent occurrence of bears. Protected areas are therefore of great importance to the protection of bears and their habitats.

The network of protected areas, though impressive in extent, suffers from several important weaknesses. Not all the land is state-owned (Tab. 3.1) and there are unresolved conflicts with landowners who wish to profit from commercial use or be compensated for lost revenue. Tourism, forestry, hunting and some agriculture are common in National Parks. Whilst this is not necessarily incompatible with nature conservation, it has also led to conflicts.

Some of the most entrenched disputes are between the representatives of different

state bodies. This is most clearly evident in Tatranský National Park, which is managed by 2 rival organisations, TANAP administration and TANAP State Forestry Service, a situation sharply criticised by the IUCN (Crofts et al. 2005). Zonation of the Park has not yet been approved. Instead, there is a highly bureaucratic system for issuing exceptions from nature protection laws. With no clear zone in which nature protection takes precedence above all other interests, there is ample opportunity for conservation goals to be undermined, as when extensive storm damage to forests in 2004 was seen by the government as an opportunity to increase mass tourism development. TANAP Forestry Service has disregarded both TANAP administration policy and IUCN recommendations relating to extraction of timber from storm-affected areas.

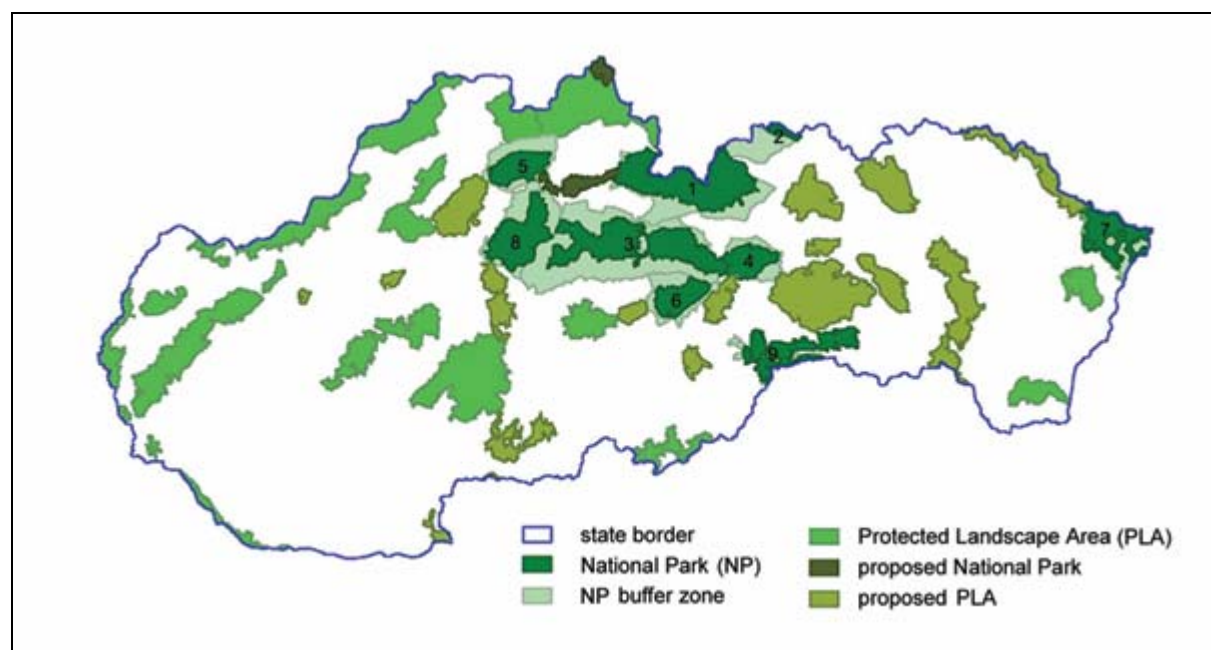
Such problems have arisen partly due to contradictions between laws on nature conservation and forestry (Viestová 2003). They also reflect differing approaches to conservation: the attempt to leave room for natural processes such as decomposition of dead wood, natural forest renewal, predation and scavenging versus continued manipulation of ecosystems, even in areas nominally set aside for wildlife.

Many protected areas have substantial networks of forest roads which allow easy access for tourists but also (illegal) fruit and mushroom pickers as well as poachers. Bears have been poached in protected areas. Widespread, large-scale collection of berries for roadside sale is believed to have a major effect on ecosystems and species in some areas. During the 1990s, enforcement of regulations in protected areas was hampered by a lack of staff. More rangers have since been employed, but some staff use pseudo-scientific observations to justify campaigns for predator control, spreading misinformation and perpetuating traditional prejudices. There have been other conflicts of interests involving National Park staff who hunt.

Even if these problems were resolved, existing protected areas are innately limited in their effectiveness. They do not include whole ecosystems: ungulates and their predators migrate to lower altitudes to over-winter outside National Park

boundaries. Connectivity is compromised, both within and between protected areas. Building has interrupted large mammal migration routes in the Tatra Mountains, despite bilateral protection (Chovancová and Kozica 2006).

Fig. 3.1 Existing and proposed large protected areas in 2006. Details of National Parks (numbered) are given in Tab. 3.1. Source: State Nature Conservancy.



Tab. 3.1. Overview of large and small protected areas in Slovakia in 2005. Some categories that protect very small areas and are therefore of little relevance to bear conservation, such as National Monuments, are not shown. Source: MP SR 2005, SMOPAJ 2006, State Nature Conservancy.

	<i>n</i>	Total core area (km ²)	Forest cover (%)	SPAs ^a (%)	State/church owned (%)	Total buffer zone (km ²)
National Parks	9	3,179	88.0			2,701
1 Tatranský		738	94.6	34.0	54	307
2 Pieniny		38	36.7	2.3	44	224
3 Nízke Tatry		728	88.5	5.5	67	1,102
4 Slovenský raj		198	88.9	13.2	74	130
5 Malá Fatra		226	82.7	11.1	15	233
6 Muránska planina		203	86.2	7.4	80	217
7 Poloniny		298	90.6	4.8	50	110
8 Veľká Fatra		404	88.0	10.1	56	261
9 Slovenský kras		346	80.3	3.0	5	117
Protected Landscape Areas	14	5,226	73.0			-
Nature Reserves	381	128		-		2
National Nature Reserves	219	837		-		28

^a Small protected areas such as Nature Reserves and National Nature Reserves lying within National Parks.

3.3.2. Ecological networks

Habitat connectivity is likely to be an important problem in the future. Slovakia, like Poland, has embarked on a major programme of road building, much of it within bear range. Environmental Impact Assessments must be carried out, but they have not always been adequate: ecologists contracted to compile an EIA for a section of highway between Tatranský and Nízke Tatry National Parks important for wildlife movements (Klescht and Valachovič 2002 p.17 citing Hell et al. 2001) had inadequate data on large mammal distribution and movements and no time in which to do fieldwork. It is important to extend habitat protection beyond protected areas to ensure connectivity. This may be achieved by establishing ecological networks.

A concept for construction of a network of protected areas was approved by government in 1976-81 (Kramárik 1995). In 1992, a Territorial System of Ecological Stability (TSES)¹³ was approved in which 77 “supraregional biocorridors” were identified. Drawing on this, a National Ecological Network (NECONET) was designed by the IUCN in co-operation with the Environment Ministry, Centre for Nature and Landscape Protection, in 1997.

In adopting the Habitats Directive on 21.5.1992, the Council of the European Communities recognised that, “*in order to ensure the restoration or maintenance of natural habitats and species of Community interest at a favourable conservation status, it is necessary to designate special areas of conservation in order to create a coherent European ecological network*”. The Directive states that, “*A coherent European ecological network of special areas of conservation shall be set up under the title Natura 2000. This network, composed of sites hosting the natural habitat types listed in Annex I and habitats of the species listed in Annex II, shall*

enable the natural habitat types and the species’ habitats concerned to be maintained or, where appropriate, restored at a favourable conservation status in their natural range.”¹⁴.

The Habitats Directive states that areas designated as special protection areas pursuant to Council Directive 79/409/EEC of 2.4.1979 (the Birds Directive) will be included in the Natura 2000 network. In addition, it also requires Member States to develop a list of potential sites of Community importance (SCI), defined as “*a site which, in the biogeographical region or regions to which it belongs, contributes significantly to the maintenance or restoration at a favourable conservation status of a natural habitat type in Annex I or of a species in Annex II and may also contribute significantly to the coherence of Natura 2000 ... and/or the maintenance of biological diversity within the biogeographic region or regions concerned ... Once a site of Community importance has been adopted ... the Member State concerned shall designate that site as a special area of conservation as soon as possible and within six years at most.*” Criteria are included for selecting sites eligible for identification as SCIs and designation as special areas of conservation. The Directive specifies that, “*For animal species ranging over wide areas, sites of Community importance shall correspond to the places within the natural range of such species which present the physical or biological factors essential to their life and reproduction.*”

Inclusion of sites in Natura 2000 does not prevent exploitation. In cases such as meadows, human intervention is required to maintain habitat. Use should be sustainable to maintain habitats and species at a favourable conservation status.

¹³ <http://www.iucn-ce.org/econets/database/?id=14>

¹⁴ http://ec.europa.eu/environment/nature/nature_conservation/eu_nature_legislation/habitats_directive/index_en.htm

At the third Ministerial Conference “*Environment for Europe*”, in Sofia in October 1995, the Council of Europe approved a Pan-European Biological and Landscape Diversity Strategy (PEBLDS), “*to conserve ecosystems, habitats, species, their genetic diversity, and landscapes of European importance through the development of a Pan-European Ecological Network*” (PEEN¹⁵). The network should consist of core areas of habitat (e.g. Natura 2000 sites) protected by appropriate buffer zones and linked up by “corridors” to alleviate fragmentation. Although PEBLDS is not legally binding, in magnitude and potential effectiveness in conservation it goes beyond the Habitat Directive’s legally binding Natura 2000 programme, which need not necessarily ensure connectivity of habitat patches.

Article 4 of the Carpathian Convention requires Parties to develop an ecological network in the Carpathians as a constituent part of the PEEN. At the First Meeting of the Conference of the Parties¹⁶ in December 2006 ministers made an official decision regarding creation of the Carpathian Network of Protected Areas (CNPA)¹⁷. A report on PEEN status and implementation should be presented to the sixth “*Environment for Europe*” Ministerial Conference in Belgrade, 2007.

In 1999 the Council of Europe, working under the Bern Convention, launched the Emerald Network, an ecological network made up of “*areas of special conservation interest*”. Slovakia joined the process of implementing the Emerald Network with a pilot project¹⁸ in September 1999.

In implementing the Habitats Directive in Slovakia, the SNC proposed a list of 382 areas for designation as SCIs covering 5,700 km² or 11.6% of the country, which is just under the EU-25 average. Overlap of proposed SCIs with existing protected areas is 86%. Locations of 61 SCIs for the brown bear¹⁹, covering a total of more than 4,110 km² (Kassa 2005), are shown in Fig. 3.2; the largest are listed in Tab. 3.2. The list of proposed SCIs was approved by the government on 17.3.2004 and sent to the European Commission for approval on 29.4.2004. Government has approved a strategy for implementing Natura 2000 up to the year 2013 (Zacharová 2006).

The SNC has published a manual for a programme of care of Natura 2000 sites and species included in Annexes of the Habitats and Birds Directives with criteria for assessing their status (Polák and Saxa 2005). Criteria for the brown bear (see Appendix VI) seem to have been defined so that present state is rated as “*favourable – average*” in most of the 9 categories. The following measures are considered necessary to maintain a favourable conservation status for the population:-

- *Maintain structure, extent and quality of beech, mixed and coniferous forests with cliffs, blow-downs and other shelter next to felled areas in sub-montane and montane areas above 600 m a.s.l.;*
- *Stop illegal hunting;*
- *Apply traditional methods of protecting sheep from predators, especially the use of livestock guarding dogs and night-time penning;*
- *Differentiate “regulation shooting” by sex and age categories to preserve the optimum population social structure.*

The manual also calls for large-scale sign survey, monitoring distribution and conducting telemetry in model areas.

¹⁵ http://www.coe.int/t/e/cultural_co-operation/environment/nature_and_biological_diversity/ecological_networks/PEEN/index.asp#TopOfPage

¹⁶ <http://www.carpathianconvention.org/framework/11.12.2006.htm>

¹⁷ <http://www.sopsr.sk/karpaty/index.php?p=6>

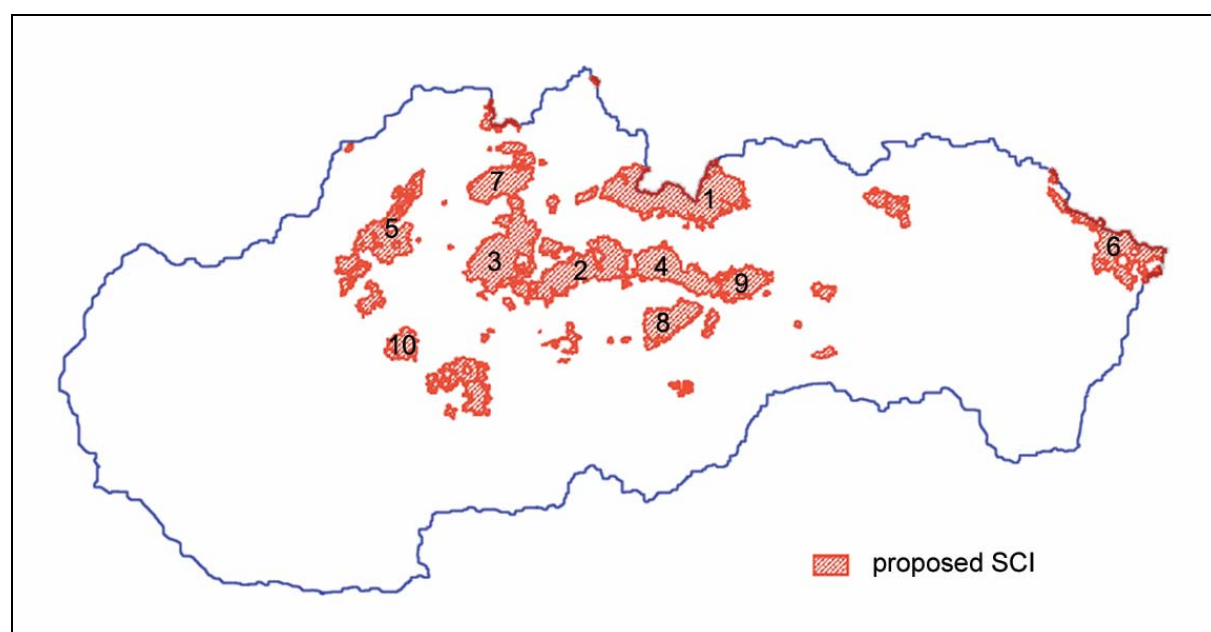
¹⁸ http://www.coe.int/t/e/cultural_co-operation/environment/nature_and_biological_diversity/ecological_networks/the_emerald_network/Pilot_project_Slovakia.asp#

¹⁹ <http://www.sopsr.sk/natura/index.php?p=4&sec=7&druh=22>

The Natura 2000 network is still very much in the implementation phase and so its effectiveness cannot yet be fully assessed. An enormous amount of work has already been undertaken in Slovakia, including mapping of species and habitats. Important deficiencies have included insufficient personnel and equipment

capacity of the SNC, poor information and public awareness and contradictions between the new Act on Nature and Landscape Protection, which transposes the Habitats and Birds Directives into national legislation, and other laws such as those on forestry (Viestová 2003, Metera et al. 2005, Zacharová 2006).

Fig. 3.2 Sites of Community importance for the brown bear proposed by the SNC for inclusion in the Natura 2000 network. The 10 largest sites (numbered) are listed in Tab. 3.2. Source: SNC.



Tab. 3.2. The 10 largest proposed sites of Community importance (SCIs) in Slovakia identified for the brown bear. Source: SNC.

Name	Code	Size (km ²)
1 Tatry	SKUEV0307	617
2 Nízke Tatry west	SKUEV0302	466
3 Veľká Fatra	SKUEV0238	436
4 Nízke Tatry east	SKUEV0310	362
5 Strážovské vrchy	SKUEV0256	294
6 Beskyd	SKUEV0229	292
7 Malá Fatra	SKUEV0252	219
8 Muránska planina	SKUEV0225	203
9 Slovenský raj	SKUEV0112	157
10 Vtáčnik	SKUEV0273	96

An obvious shortcoming of Natura 2000 for brown bears in Slovakia is the relative lack of SCIs proposed in the area between the core of the West Carpathians and the East Carpathians, so connectivity between these 2 sub-populations is not safeguarded. Proposed SCIs for the bear in Poland²⁰ only partially improve this situation. Insufficient connectivity between sites and lack of cross-border coordination with neighbouring states have been identified as important weaknesses in implementation of Natura 2000 in Slovakia (Metera et al. 2005). Core areas for bear conservation should be at least 3,500 km² (Van Maanen et al. 2006), as in Slovenia (Kryštufek et al. 2003), and have good connectivity.

²⁰ <http://natura2000.mos.gov.pl/natura2000/>

3.3.3. Restoration/recovery

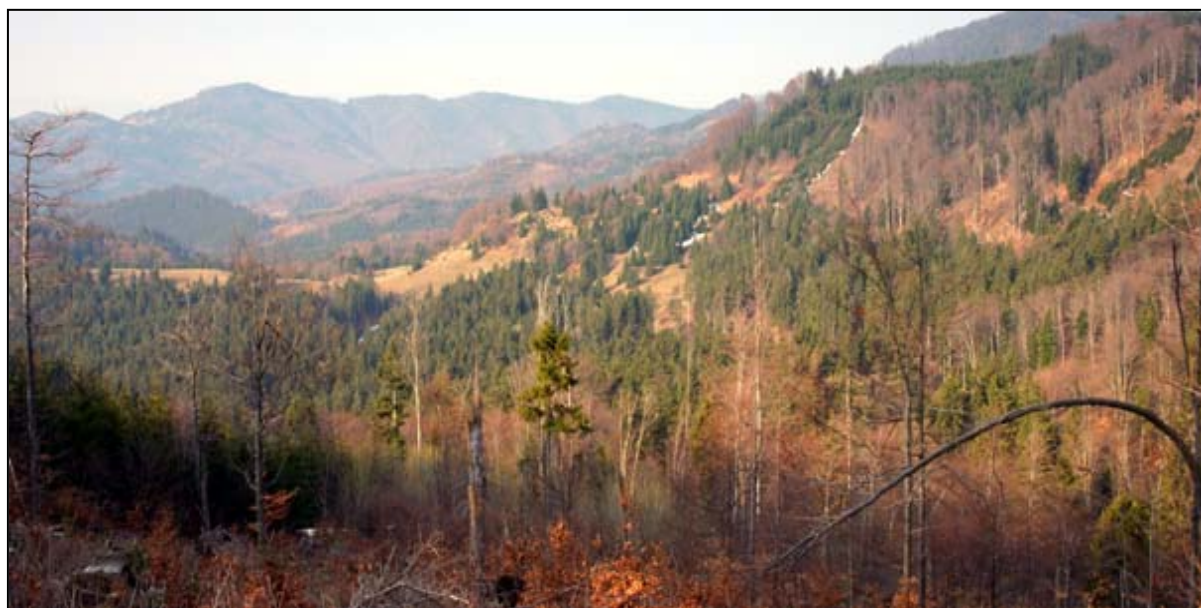
Before colonisation by humans, the area of present day Slovakia was more than 95% forested (Mind'áš et al. 2006) and bears presumably occurred throughout the country. The destruction of primeval forests by human settlers was most marked from the 11th to the 15th centuries, but intensive use and destruction of forests continued into the 18th century, including the clearance of forests for livestock grazing in mountain areas. The loss of forest habitats was gradually reduced during the 18th-20th centuries as forestry became more sustainable. Some areas were set aside for wildlife and to preserve remaining fragments of primeval forest (Mind'áš et al. 2006).

In addition to the declaration of protected areas, during the 20th century there was a concurrent (or sometimes preceding) process of spontaneous habitat restoration in response to decreased human exploitation. This included an expansion of forest cover, the recovery of large ungulate populations (Voskár 1993), a marked decline in livestock grazing – particularly in mountain ranges – and the abandonment of fields and orchards. Wolf recovery could also have been of benefit to bears through making more ungulate carcasses

available. It has been estimated that the volume of timber in Slovak forests has more than doubled since the 1950s. The area of forest land has increased by c.9% since 1953 to a present total of 19,310 km², c.41% of the country (Mind'áš et al. 2006). According to the IUCN, approximately two thirds of the total area of Slovakia has a relatively well preserved natural landscape.

No study has been conducted in Slovakia to assess the contribution made by these changes to the recovery of the bear population, but it is likely to have been substantial. In Russia, Ukraine and the Caucasus the presence of brown bears has been found to be closely related to the amount of forest cover and level of human disturbance (Baskin and Vaisfeld 2005, Vaisfeld 2005).

Whilst some changes favourable to bears are continuing, such as the decline in livestock grazing and abandonment of agricultural land, others may be undone by new economic situations and policies such as rural and regional development. Habitat is being lost to construction or expansion of tourism facilities, industrial complexes and urban areas, and fragmented by new or enlarged transport corridors, particularly highways.



3.4. Species protection

Protected areas are neither big enough nor sufficiently connected to preserve viable populations of large carnivores in isolation. Brown bears have large home ranges and need access to different habitats at different times of year so they often move outside protected areas (Huber and Roth 1993, Jakubiec 2001). Conservation of bears thus requires their presence beyond protected areas, where they need a degree of species protection to ensure that enough individuals survive. Protective legislation is unlikely to succeed without public support, especially if there is a belief that breaking the law to reduce damage or danger is justified and such infringements are seen to go unpunished (Ďurík 2000). A balance is therefore required between conservation and minimising conflicts with humans (Linnell et al. 1996, 2005, Woodroffe et al. 2005).

The brown bear has been formally listed as a protected species in Slovakia since 1965 (Kassa 1996), but measures intended to ensure its survival were enacted much earlier. A ban on hunting in 1932 has often been cited as the first measure to prevent the extirpation of bears in Slovakia. However, efforts to maintain and increase numbers of bears for sport hunting pre-date the ban. Supplementary feeding of bears in the High Tatras can be traced back to at least 1905 (Feriancová 1955), when there was also an attempt to augment the population in the Poľana area of central Slovakia using bears brought from Romania (Teren 1987a, Hell and Find'o 1999, Hell and Slamečka 1999).

Since 1.1.2003, the Nature and Landscape Protection Act (no. 543/2002) has implemented EU Council Directive 92/43/EEC on Conservation of Natural Habitats and Wild Fauna and Flora (usually known as the Habitats Directive) into national legislation. In Decree no. 24/2003, the brown bear is listed in Annex 4B as a priority species of European

importance for which protected areas could be designated and in Annex 6A as an autochthonous species, the “*societal value*” of which is 80,000 Sk (c.€2,300) per individual.

The capture, wounding, killing and damaging the habitats of protected animals is prohibited. The state pays compensation for damage caused by protected species to the life/health of natural persons and to livestock, beehives, guard dogs, forest stands, unharvested crops, fish in fish farms/ponds and, in some cases, to some game species.

Hunting was historically and continues to be the largest known cause of bear mortality in Slovakia. Bear conservation therefore requires the strict regulation of hunting. This measure has widespread public support, including by three-quarters of people in areas with bears and those directly affected by them (Wechselberger et al. 2005). A legal harvest is made possible by a system of exceptions to laws on nature protection and hunting as well as by a reservation from the Bern Convention on the Conservation of European Wildlife and Natural Habitats. Mortality by legal harvest has probably been below the maximum sustainable yield for the past 12 years. Poaching has also not prevented population growth.

The hunting management of bears is now zoned (cf. Linnell et al. 2005) in the sense that, since 1999, “*regulation shooting*” has been excluded from National Park core areas and smaller areas with protection level 3 or higher (c.7.7% of Slovakia), but is allowed elsewhere, including National Park buffer zones (Kassa 1999b, 2000a,b). Proposals for zoning on a broader scale (Baláž 2003) have not been adopted. Public opinion is divided on whether carnivores should be eliminated from areas where they kill livestock, but in general people are against the idea that they should only live in restricted parts of Slovakia (Wechselberger et al. 2005, Jób 2007).

3.5. Hunting

Brown bears are hunted throughout most of their global range (Swenson 2005). Historically, unlimited hunting reduced and in some cases eliminated populations of bears and other large carnivores (Breitenmoser 1998, Woodroffe et al. 2005), including those in Slovakia. Eradication was often the goal in order to remove an animal regarded as a competitor, a crop raider or a threat to livestock and human safety. It is important to distinguish hunting that, either intentionally or due to lack of sufficient regulation, threatens the survival of a particular species from hunting that, at least in principle, aims to sustain populations in order to allow exploitation to continue indefinitely. The latter is not necessarily incompatible with conservation of threatened species (LCIE 2002).

Regulated hunting is now a very widespread form of wildlife management. There are numerous examples of bear populations that have increased while being subject to regulated hunting (Knapp 2006). In some countries, e.g. Romania, trophy hunting contributed to the persistence of bears as well as other large carnivores and continues to be an incentive for hunters to support their conservation. Leading experts in carnivore conservation have identified several other potential benefits to allowing carefully regulated hunting, if certain conditions are observed (see LCIE 2002). It may, for example, help to maintain carnivores' natural wariness of humans, thus reducing the likelihood of attacks on humans (Swenson et al. 2000), although there do not seem to be any published data confirming this. In Slovakia, some of the revenue from trophy hunting is used to pay compensation for damage caused by bears to agriculture.

On the other hand, human-caused mortality, including due to hunting, is one of the main causes of population decline in several brown bear range states (Knapp

2006). The long-term effects of harvesting on the social dynamics and evolution of bears are largely unknown, but could be considerable (Swenson 2005).

Slovakia is an interesting example of the effects of different hunting regimes on a bear population. Although excessive hunting was primarily responsible for almost eradicating bears from the West Carpathians by the 1930s, and a ban on hunting from 1933 to 1957 was sufficient to allow the population to recover, population size and distribution have continued to increase despite introduction of hunting with quotas from 1958-62.

Published sources on the development of hunting management in Slovakia in the 20th century often contradict each other and in several cases there are even contradictions within the same article. Some important inconsistencies are mentioned in the following review.

3.5.1. Historical overview

Up to 1932: hunting and persecution

Josephine's hunting order of 1738 permitted the killing of bears by any person using any means (Hell and Findo 1999). In 1780 (1786 according to Halák 1993), Austrian Emperor Jozef II passed a hunting regulation, which was valid in the area of present-day Slovakia, permitting landowners and users to kill unlimited numbers of bears as well as other animals that caused damage to livestock or crops. Bounties were paid (Karč 1977).

Hungarian hunting laws (VI/1872, XX/1883) also gave all citizens in the area of present-day Slovakia the right to kill "*predatory and harmful game*", including bears and wolves, on their own land. Many methods were used, including watch, stalk, drive and lure, with tools such as the cross-bow, traps, snares, masked pits and strychnine (the latter in 1855-1880 and intended mainly for wolves). A reward of 10 guldens (enough to buy c.130 kg of wheat) was paid per bear, to which were

added additional financial or material rewards from grateful locals and income from the sale of body parts.

There were specialist bear killers in some villages (Karč 1977, Halák 1993, Jamnický 1993, Hell and Slamečka 1999). According to historical documents from Liptov, northern Slovakia, examined by Karč (1977), during the period 1791-1850 more bears were killed by forestry employees (52% of 291 bears killed) than by villagers (35%). Sport hunting by the nobility was also very intensive in some cases. In 1901, for example, 11 bears were killed in a single day in the hunting grounds of a nobleman in eastern Slovakia (e.g. Teren 1987a).

In Liptov, most bears were killed in April-June (44%) and September-October (31%). The fewest number of bears were killed in March, January-February, July and November (Karč 1977).

According to Hell and Slamečka (1999), the bear population in Slovakia was substantially reduced during the 19th century. Bears seem to have been eradicated from southwest Slovakia before the turn of the 20th century. A combination of intense persecution to eliminate damage to beehives or livestock and excessive sport hunting evidently caused a rapid decline in numbers and range. This is reflected in a decline in the mean annual harvest in the area of present-day Slovakia, which was approximately 42 bears in 1885-94 (Hell and Find'o 1999 citing Hell and Sládek 1974), 31 in 1892-1909 (Jamnický 1993) and 14 in 1924-29 (Hell and Slamečka 1999 p.75). (According to Halák 1993, citing Randík 1971, 180 bears were harvested in 1926-29, and according to Jerguš 1972 it was 189, but these statements are contradicted by other sources.). At the time of the First World War there were only c.120 bears left; some contemporary estimates for the early 1930s were as low as 20-30 individuals (in Hell and Sládek 1974).

1932-33 to 1957-61: no hunting

Due to critically low numbers, there was no legal harvest of bears in the area of present-day Slovakia from 1933 until 1957 (Janík 1997). Bylaw no. 127 203/14-1932 banned bear hunting from 1.9.1932 (Halák 1993) or 15.6.1933 (Hell and Slamečka 1999 p.106), subsequent decrees extended the ban, but these regulations only applied to hunters (Hell and Find'o 1999). Landowners could still kill bears on their own land until a hunting law passed in 1947 (Act no. 225) made killing bears illegal (Halák 1993). There seems to be little published information on bears killed in 1933-47 (Karč 2007 mentioned a hunter shooting a bear in 1936, thinking it was a wild boar), but it was perhaps not many because there were few bears, presumably there was little damage and the trend of expert estimates suggests that population recovery began before landowners' rights to kill bears were rescinded (see Fig. 1.4).

1958-62 to 1979 (1988): trophy hunting

By the late 1950s and early 1960s there were probably c.200 bears in Slovakia (Sabadoš and Šimiak 1981). (Janík 1997 as well as Martínková and Zahradníková 2003 stated that there were 300-400 bears in 1962 but graphs of estimated population size in their papers do not agree with the accompanying text; expert estimates were 220 individuals in 1962 and 300-330 in 1966-71.) Due to increased damage to beehives, crops and livestock, hunting was resumed. According to Halák (1993), 1-2 individuals were shot per year from 1958. Kassa (1998b) and Karč (2007) also indicate there was hunting from 1958. Sabadoš and Šimiak (1981) mentioned 1960 as the year in which hunting was resumed, according to Šprocha (1977) it was 1961 while several other authors (e.g. Hell and Find'o 1999) give it as 1962, when a new Hunting Act became valid.

The main management goal of hunting was to prevent further population increase by removing "excess" individuals above a

theoretical “optimal” population size of c.400 individuals (Teren 1987a) as set in a *Concept for the Development of Hunting in the Slovak Socialist Republic* (Volček in lit.). Despite the quota being increased to 10 bears, equivalent to slightly less than the annual population growth rate of 5-6% as estimated by Sládek (1969), numbers continued to increase. The annual quota was c.20-30 individuals in 1960-70 and 35 in 1972-76 (Šprocha 1977). According to Sabadoš and Šimiak (1981), hunting began to have an impact on the “core” of the population from 1972.

Management institutions estimated bear numbers by locality and co-operated with central institutions of the State Administration of Conservation of Nature, responsible for hunting administration (Janík 1997). Hunting was supposed to be focussed on higher density core areas, not in marginal areas, in order to allow further range expansion (Martínková and Zahradníková 2003). Licenses were only issued to branches of the State Forestry Service (Šprocha 1977) but were usually sold to foreign trophy hunters. Of 117 bears shot legally in 1971-76, 68 (58%) were shot by foreign fee-paying trophy hunters, 24 (21%) by guests of the Forestry and Water Management Ministry, 14 (12%) by Czechoslovak fee-paying trophy hunters, 7 (6%) were problem bears shot in summer, 3 (3%) were shot by hunters in self-defence and 1 was shot for a museum.

Hunters were “*motivated mainly by the profit from trophy hunting*” (Janík 1997), which during the Communist regime was seen as a way to bring hard currency into the country (Teren 1987a). No restrictions were placed on the age, sex or weight of bears that could be harvested. As a result, hunters focussed on the biggest bears to get the best trophies. Apart from the skull of a large bear found dead in 2004, the top 10 trophies in Slovakia of both skulls and furs all come from bears shot during the period 1959-88, more than half of them before 1980 (Červený et al. 2004b).

During the period 1958-80, 230 of 291 (79%) legally shot bears were male (Janík 1997). Observations of model areas suggested that this resulted in a distortion of the age-sex structure of the population, creating a shortage of adult male bears and increased proportions of females and young bears (Janík 1982, 1987). Jamnický (1987) estimated that in the 1970s hunters removed 80-90% of large males.

Permits were also issued to remove problem bears. In the 1970s, c.3-7 such exceptions were issued per year, but on average only 1 was realised (Šprocha 1977). The system was often abused in order to obtain trophies (Hell and Sabadoš 1993), particularly for prominent guests (Halák 1993). Hunters tended to shoot the largest bear visiting a baiting site, which might not have been a problem individual (Hell and Sabadoš 1993, Martínková and Zahradníková 2003). Bears from protected areas were shot when moving into agricultural lands to use seasonal food sources. Another way in which the system was abused was by shooting several bears at the same locality (Kadlečík 1983).

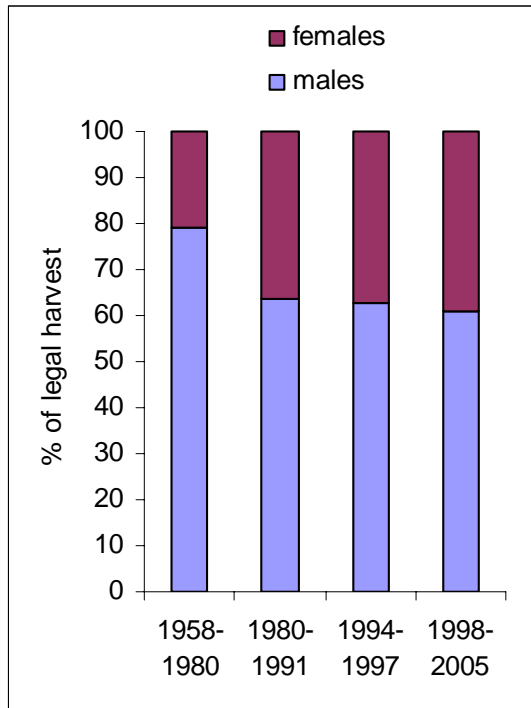
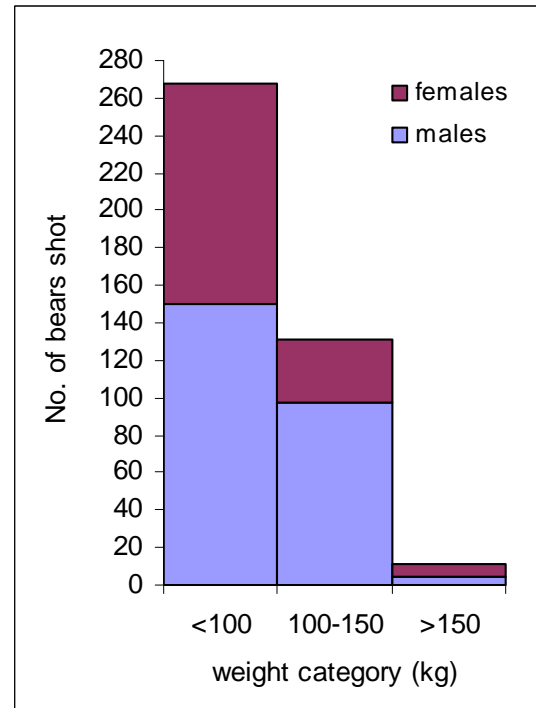
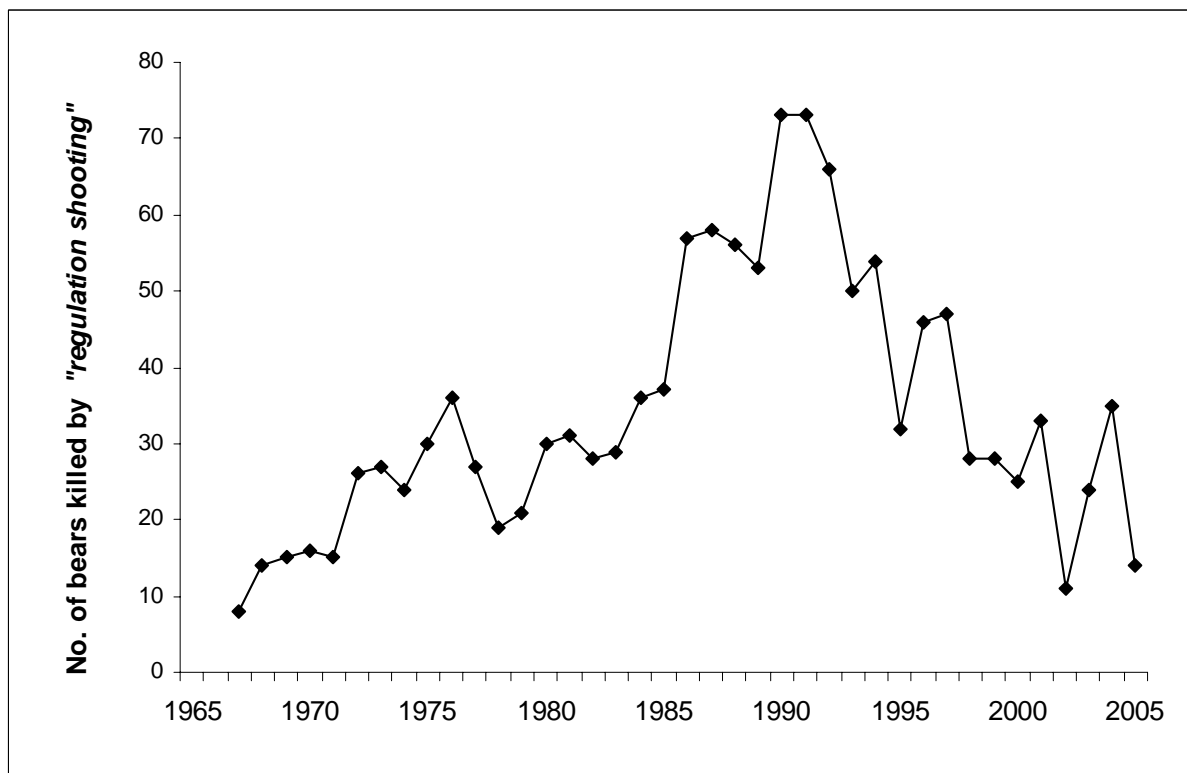
1980 to 1993: quotas by weight category

Martínková and Zahradníková (2003) stated that size criteria were not incorporated into hunting quotas until 1989, but this appears to be incorrect. According to Kassa (1998b), this began in 1980 with the introduction, at the request of the SNC, of 3 weight categories, each with its own quota: up to 100 kg (40-50%), 100-200 kg (40-50%), >200 kg (10%).

By the imposition and adjustment of a structured quota, hunting was gradually focussed more on the smaller weight categories with the intentions of:-

- *targeting subadults;*
- *increasing the proportion of females (without cubs) harvested;*
- *protecting the remaining old territorial males.*

(Kassa 1998b)

Fig. 3.3. Sex ratio of 1,144 bears legally shot in 1958-2005. Sources: see Tab. 3.3.**Fig. 3.4.** Sex ratio by weight of 410 bears shot in 1994-2005. Sources: see Tab. 3.3.**Fig. 3.5.** Annual variation in the number of bears killed by “regulation shooting” in Slovakia in 1968-2006. Sources: records held at the State Nature Conservancy of the Slovak Republic, Kassa 1995, 1998b, 2000a, 2001a, 2002a, 2003, 2006, Červený et al. 2004b.

The boundary of middle and upper categories was adjusted to 150 kg in the mid-1980s (Kassa 1998b). According to Janík (1997), the intention was for 65% of harvested bears to be <100 kg (more likely to be female or subadult) and 35% to be 101-150 kg. Implementation of the plan was problematic because hunters wished to continue trophy hunting. Hunters often reported shot bears to be smaller than they actually were (Hell and Sládek 1994). Nevertheless the proportion of males harvested declined: 281 of 441 bears (64%) legally harvested in 1980-91 were male (Janík 1997). See Fig. 3.3.

In 1980, when 28 bears were shot (Martinková and Zahradníková 2003), the harvest quota was increased to 8-10% (Janík 1997, Kassa 1998b). Hell (1987) suggested increasing the quota to 12% or more as a temporary measure to reduce the population, but this was not implemented. Nevertheless it appears that legal harvest may have exceeded maximum sustainable yield from 1987 to 1993, when it was a management goal to reduce the population to 450 individuals (Kunc 1996 p.58). The reported harvest during this period seems to have been 9.8-13.2% of the total population size based on expert estimates.

The majority of bears shot in 1980-91 were in higher density core areas. However, there was also hunting on the periphery of the population, despite a policy of allowing range expansion, particularly in eastern Slovakia where the intention was to promote reconnection of the West and East Carpathian sub-populations (Hell and Sabadoš 1993).

Records from 1990-91 show that two-thirds of 113 bears were shot between 19:00h and 23:00h. Half of them were shot from a distance of less than 50 m. It was common for hunters to shoot from inside hunting lodges, firing through a window.

Since the beginning of the 1990s the hunting of bears weighing over 150 kg has not been allowed (Kassa 1998b) except in

exceptional circumstances (Janík 1997). Preference was given to removing problem bears, such as those feeding on refuse or repeatedly damaging livestock. Field staff of the SNC were to work with hunters to select localities and bears for harvest and hunters became obliged to report standard body measures of every bear shot.

Since 1992, nuisance bears have been included within the total quota in order to end abuses of the system for removing problem bears motivated by the desire to conduct additional trophy hunting (Hell and Sabadoš 1993, Kassa 1995).

Since 1994: strictly regulated hunting

A new law on protection of nature and landscape (Act no. 287/1994) was passed in 1994 and became valid on 1.1.1995, bringing several important changes to the hunting management of protected species. It became a legal requirement to have an exception from the Environment Ministry as well as from the Agriculture Ministry in order to permit bear hunting (Kassa 1996). Locations for hunting were set by Forest Offices upon agreement with District Environmental Offices. Several other regulations were tightened. Not only did each bear shot have to be reported but SNC personnel had to be called to examine the carcass to verify that conditions had been met (Kassa 1995, 1998b, 2003). Organisations found to have broken the rules would not be granted a licence for bear hunting in the following year.

The policy of targeting lower weight categories in order to reduce the male bias among harvested bears was continued. All known mortality was included in the overall annual quota. In 1994, the hunting plan called for 65% of harvested bears to be <100 kg and 35% to be between 100 and 150 kg. The actual proportions of these weight categories among 57 known bear deaths (both hunting and non-hunting) were 69% and 31% respectively (Kassa 1995). In 1995, 54 of 78 permits (69%) were issued for bears <100 kg and

24 (31%) were for bears weighing 100-150 kg. Of the 45 shot bears for which a weight category is given in the records, 78% were <100 kg.

Nevertheless during the period 1994-97, 63% (114/182) of bears shot legally were male (Kassa 1998b), i.e. there was no significant decrease in the proportion of males shot compared to 1980-91 (Fig. 3.3). This is largely because one third of all bears shot legally weighed between 100 and 150 kg and around three quarters of shot bears in this weight class were male (Fig. 3.4). In addition, conditions for hunting were often not met. In 1998, 9/47 (19%) of successful hunts exceeded the permitted weight limit (Kassa 1999b).

Since 1998, c.90% of permits were issued for bears <100 kg, 10% for 100-150 kg and none for bears weighing >150 kg. Even this measure achieved only a slight and not statistically significant reduction in the take of males: 140 of 230 (61%) bears shot legally in 1998-2005 were male. As can be seen from Fig. 3.4, even the <100 kg weight category of shot bears is male-biased: 150 males to 118 females (one-group $\chi^2 = 3.88$, d.f. = 1, $p = 0.049$). This suggests that without other conditions changing it may be impossible to maintain a 50:50 sex ratio among harvested bears, although the harvest would almost certainly be more male-biased if it were permitted to hunt bears >100 kg.

Large males tend to be selectively targeted by trophy hunters: 79% of bears shot in 1958-80 were male. Since then, stricter regulations have reduced the male bias to 58% in 2000-05.



For comparison, 54% of 375 bears legally harvested in Sweden in 1981-91 were male, which is not statistically different from a 50:50 sex ratio. The hunting season in Sweden during that period was from 1.9. to 15.10. (Swenson et al. 1994). Danilov (1994) believed that “moderate” hunting pressure (4-5% of the population) had not significantly altered the age-sex structure of bear populations in northwest Russia. The sex ratio of bears in Croatia is thought to be natural, i.e. 1:1, despite heavily male-biased trophy hunting (Dečak et al. 2005). In contrast, it is acknowledged in Romania that trophy hunting selectively removed males (Șelaru and Ionescu 2005).

Several additional restrictions were imposed in Slovakia from 1999-2000. Spring hunting has not been allowed since 2000 (except for individuals up to 60 kg in Poľana in 2001) in order to reduce the risk of females with dependent cubs being shot. The new season for “regulation shooting” was set from 1.6. to 30.11. (Kassa 2001a, 2002a). Because in the past baits had often not been removed after hunting (Kassa 1997), use of carcasses was excluded from protected areas in 1999 (Kassa 2000a) and banned completely in 2000 (Kassa 2001a). Hunting bears was restricted to areas with nature protection levels 2 (National Park buffer zone, Protected Landscape Area) and 1 (open country) from 1999 (Kassa 1999b, 2000a,b). From 2000, only bears less than 100 kg or with a front paw width up to 12 cm and hind paw length up to 21 cm could be legally hunted.

Banning spring hunting and use of meat baits as well as focussing quotas on lower weight categories are often cited as reasons for decreased hunter success (e.g. Hell 2003). In the period 1994-97, 31-54 bears were shot per year, representing 48-80% (average 66%) of the annual quota (Kassa 1998b), whereas in 2000-06 according to records held at the SNC 11-35 bears were shot per year, representing only 15-52% (average 35%) of the annual quota.

In 1995, whereas 64% of permits were for spring hunting, 74% of harvested bears were shot in spring. However, this is not a statistically significant difference. Kassa (1997) noted that, in 1996, spring hunting was twice as successful as autumn hunting, which he attributed to the “inability” of hunters to conduct hunts at bait in autumn. Spring hunting and the use of meat bait were not phased out until 1999-2000, whereas hunter success has been declining since reaching a peak in 1991-92 (Fig. 3.5). It therefore seems reasonable to conclude that the degree to which quotas have been filled was affected in the first instance not so much by the banning of spring hunting and baiting with carcasses but other factors, such as the sharper focus on smaller weight categories and tighter controls on the observance of regulations.

Stricter regulations were not the only cause of quotas not being filled. Since 1994, bodies other than the State Forestry Service have been permitted to hunt bears. In the first year of this change, 15 other bodies (town or district forestry services, hunting associations and land management bodies) were issued licences (Kassa 1995). In 1995 this was increased to 23, 17 of them hunting associations (Kassa 1996). At least initially, these bodies were less successful. While the State Forestry Service shot 39/45 (87%) permitted bears in 1994, other bodies shot 8/13 (62%) bears they were permitted to hunt (Kassa 1995). The difference was insignificant in 1996, when the State Forestry Service shot 19/39 (49%) permitted bears, compared to 12/27 (44%) by other bodies (Kassa 1997). Kassa (1995) also noted that non-Forestry Service bodies often arrange hunts at weekends, causing additional difficulties for SNC staff responsible for checking that regulations are respected.

It is important to realise that quotas for bear hunting have never been consistently filled in Slovakia, even when they were set at only 5% of the population estimate. In 1961-71, 77 of 115 (67%) permitted bears

were shot (Jerguš 1972). This was perhaps because during Communism only prominent officials and paying guests were legally permitted to hunt bears and they usually did not have enough time (Hell and Sabadoš 1995). Interestingly, according to official records, quotas for bear hunting have very rarely been filled in Romania and hunter success has apparently declined substantially since the 1980s (Şelaru and

Ionescu 2005). In Croatia, too, quotas have not been filled. Known mortality in 2000-02 was only 56-70% of the planned hunting quota. The main reasons included unfavourable meteorological conditions, difficulties in achieving good fees and less interest from foreign hunters (Dečak et al. 2005). Applications for permission to hunt bears in Slovakia declined during the period 1996-2006 (Tab. 3.3).

Tab. 3.3. Overview of the two systems of bear hunting management in Slovakia, a regular harvest quota intended to control the population (*“regulation shooting”*) and the removal of nuisance bears (*“protection shooting”*), used concurrently in 1994-2006. The data are incomplete. Where sources contradict each other (which is quite common), the most credible or median values have been used, including to calculate the percentages of quotas filled. Sources: compiled from records held at the State Nature Conservancy of the Slovak Republic, Kassa 1995, 1996, 1997, 1998b, 1999a,b, 2000a, 2001a, 2002a, 2003, 2006, Hell et al. 2001, Lehocký et al. 2003b, Červený et al. 2004b.

Year	Regular harvest quota (<i>“regulation shooting”</i>)					Removal of nuisance bears (<i>“protection shooting”</i>)				
	Requested	Recommended	Permitted	Filled		Requested	Recommended	Permitted	Filled	
				<i>n</i>	% of permitted				<i>n</i>	% of permitted
1994			(60 ^a)	48	(80)				2	
1995			(78 ^a)	48	(62)				5	
1996	135		65	31	48			0		
1997	112		64	46	72					
1998	144		71	47	66				3+1 ^b	
1999	152		67	28	42				1	
2000	134		74	28	38			6	2	33
2001	122		68	25	37			4	(1 ^b)	0
2002	124		70	33	47			7	6	86
2003	123	69	74	11	15			5	2	40
2004	102	63	63	24	38	26	20	18	9	50
2005	104	56	68	35	52	10	9	9	0	0
2006	122	70	69	14	20	14	12	8	2	25
Total			891	418	-				34	-
Mean	124.9	64.5	68.5	32.2	43.2	16.7	13.7	7.1	2.6	33.4

^a Includes all known mortality (Kassa 1995). ^b Captured alive (Kassa 2002a).

3.5.2. Present situation

The brown bear is protected year-round according to both hunting and nature protection laws. However, on the basis of exceptions from national and international ordinances, bears are hunted legally under two parallel systems: population control and removal of problem individuals.

Population control

The most common hunting system, in terms of numbers of bears shot, is the planned limitation of population growth by lethal control, known as “*regulation shooting*” (“*regulačný odstrel*” in Slovak). The annual quota is for a total known loss from the population, including by hunting, removal of nuisance bears and all other causes of mortality, of up to 10% of what is believed to be a fairly reasonable “guesstimate” of the total number of bears in Slovakia (currently 700-750 bears, i.e. not the “official” estimate based on the annual game census by hunters known as Poľov 1-01). The proportion of the population actually removed is less than 10% for two main reasons: 1) the “*regulation shooting*” quota is never filled; 2) the West Carpathian sub-population extends into Poland and the Czech Republic, where hunting is not allowed (Okarma et al. 2000, Jakubiec 2001).

The Environment Ministry and SNC have placed an emphasis on limiting the negative impacts of hunting on the bear population and regard the quota as a maximum limit rather than a management goal (M. Kassa pers. comm.). Their intention is to stabilise the population or allow slight growth (Adamec et al. 2005), manipulating the structure of the quota to target females and younger bears in order to rectify suspected deformation of the population’s age-sex structure.

Details of conditions are modified each year by the SNC according to new legislation or practical issues, but the general framework for current

management has been in place since 2000. Recently (including in 2006) the following conditions have applied to ensure sustainable hunting management of the bear population in Slovakia:-

- *The annual quota, including all known mortality, should not exceed 10% of the estimated population;*
- *Hunting is permitted from stands over bait (“*postriežka*”) from 1.6. to 15.12. and by stalking (“*posliedka*”) from 1.6. to 30.11.;*
- *Hunting is permitted preferentially in areas where damage or conflict with humans occurred in the previous year;*
- *Hunting is not permitted in eastern marginal areas of the range to facilitate the connection of the West and East Carpathian sub-populations.*
- *Only bears weighing < 100 kg or with a front paw width < 12 cm and hind paw width < 21 cm may be shot;*
- *No meat bait is allowed;*
- *Hunting is not permitted in protected areas of level 3 and above (National Park core areas, Nature Reserves and National Nature Reserves);*
- *Shot bears are measured by State Nature Conservancy staff to provide data and samples as well as to check that conditions have been met.*

As well limiting population growth, a second management goal of “*regulation shooting*” is to reduce bear-caused damage and risk to humans by issuing permits to hunt bears primarily in areas where:-

- *SNC staff anticipate that an increased density of bears may lead to encounters with people;*
- *there was damage in the previous year;*
- *there are recreation areas and there might be an increased risk of tourists encountering bears.*

(Adamec et al. 2005)

Applications for permission to hunt bears must be submitted to both the Environment Ministry and the Agriculture Ministry (Hell and Slamečka 1999). All applications are considered together by a commission of the SNC (initially after 1994 by the Slovak Environmental Agency). This commission proposes the numbers, areas and conditions for the annual hunt. Its proposals are sent to the Environment Ministry, which issues exceptions from the law on nature and landscape protection in consultation with the Agriculture Ministry, which issues exceptions from the law on hunting. Hunting ground users that infringed regulations in the previous year are likely to be refused permission. Official procedures for “*regulation shooting*” are described in Appendix IV.

Bear hunting in Slovakia is largely recreational, i.e. motivated by enjoyment of the hunt itself, as well as pride and satisfaction in obtaining a valued trophy. There is also an economic component as shooters are, typically, the paying guests of hunting ground users (see Tab. 1.11). Many of them are foreigners, but the majority are Slovaks, typically wealthier individuals such as businessmen and politicians. SNC records show that of 156 bears shot in 2000-05, 59.6% were shot by Slovaks, 19.9% by Czechs, 7.1% by Austrians, 4.4% by Germans, 2.6% by Poles and 6.4% by other nationalities.

In contrast to the Environment Ministry and the SNC, the Agriculture Ministry, Forestry Service, Slovak Hunting Union and other hunting advocates consider population control essential and regard the quota as a hunting plan that should be filled. This stems from a belief that there is an “*optimal*” population size and density at which bear numbers should be maintained by removing any “*excess*” individuals (e.g. Hell 2003).

Hunting over bait from elevated stands is the most commonly used method and is permitted from 1.6. to 15.12. In practice,

bears are usually shot in autumn (Fig. 1.7), because summer furs are regarded as being of lower quality.

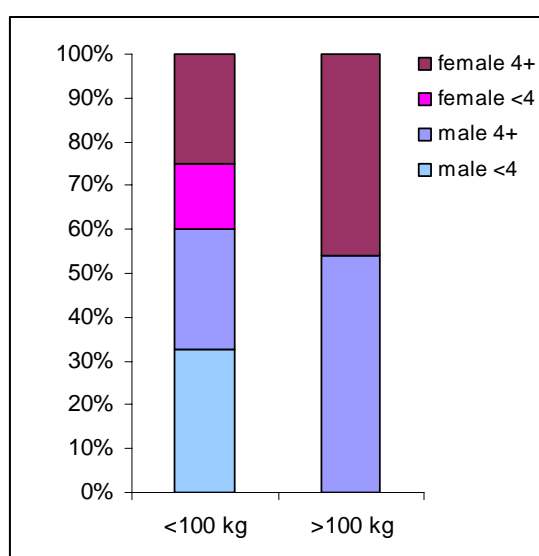
Since 2003 hunting by stalking has also been permitted (Kassa 2006) but only until 30.11. in order to avoid hunters following bears to their dens (M. Adamec pers. comm.). In the last 3 years exceptions to allow hunting did not become valid until August-September due to delays in the legislative process as a result of objections raised by environmentalists (Ondruš 2005, M. Adamec pers. comm.).

The proportion of the annual hunting quota that is filled has shown a downward trend since 1991-92 (Fig. 3.5, Tab. 3.3). The recent anti-hunting campaign by environmentalists has had no discernible effect on the number of bears shot: in 2004-06, hunting success was 33% (69 bears shot from a total quota of 212) compared to 35% (70/200) in 2001-03. Reasons for the failure to fill quotas suggested by local experts in the minutes of bear hunting management meetings include:-

- *no interest from hunters in summer as trophy quality is considered poor;*
- *bad weather in autumn;*
- *absence of bears of stipulated weights visiting bait sites in autumn (in turn resulting from seasonal migration and/or abundance of other (natural) food sources);*
- *disturbance caused by large numbers of mushroom pickers in hunting grounds;*
- *fee-paying trophy hunters not having sufficient time or not being present when bears were visiting bait sites;*
- *mistakes made by the hunt organisers or the shooter;*
- *little interest in shooting bears <100 kg;*
- *hunters too concerned that might incur a penalty by shooting a bear that does not meet the criteria;*
- *increased illegal hunting.*

Despite the intended focus exclusively on hunting bears less than 100 kg, of 155 bears shot in 2000-05 for which a record of weight was available, 62.6% weighed up to 100 kg, 31.6% were 101-150 kg and 5.8% were over 150 kg. The average weight was 96.5 kg (range 28-200 kg), compared to an average weight of bears shot in 1989-91 of 102 kg (SNC records, Hell and Sabadoš 1993).

Fig. 3.6. Sex, age and weight categories of 64 bears shot in 2003-05. Source: SNC records.



The sex ratio of bears shot in 2000-05 was 58.3% males to 41.7% females. The proportion of bears shot by “*regulation shooting*” in 2003-05 that were females 4 years old or older (i.e. potentially of reproductive age) was 21/64 (32.8%): 10/40 (25%) of bears up to 100 kg and 11/24 (46%) of those over 100 kg (Fig. 3.6). According to Fisher’s exact test, the difference between the 2 weight categories is not significant. The average age of all shot females up to 100 kg was 5.3 years (range 2-20) compared to 7.9 years (range 5-15) for heavier females, a significant difference (Mann-Whitney *U*-test, $p = 0.0027$). Only 30% of all bears shot in 2003-05 were less than 4 years old. This situation has not been accurately portrayed by hunting advocates and the media.

Removal of “problem” individuals

The second system of legally killing bears in Slovakia is called “*protection shooting*” (“*ochranný odstrel*” in Slovak). It provides for the removal of specific, problem individuals in cases of conflicts with people, high and repeated damage to livestock and beehives or human habituated and food-conditioned bears.

Exceptions from the law to allow problem bears to be removed by “*protection shooting*” are issued by Forest Offices in agreement with District Environmental Offices (Kassa 1996). Official procedures for permitting the removal of problem bears are outlined in Appendix V.

Of 14 bears shot by “*protection shooting*” in 1998-2004 and for which data were available from SNC records, 43% were shot as human food-conditioned individuals, 29% had allegedly damaged beehives, 21% livestock and 7% fruit trees. The success rate of “*protection shooting*” seems to be lower than that of “*regulation shooting*” (Tab. 3.3): 33% compared to 35% of bears permitted to be shot under the respective systems in 2000-05.

Almost all removal of problem bears is done by Slovak, rather than foreign, hunters: in 1998-2004, 17 of 19 problem bear removals (89%) for which data were available were shot by Slovak hunters. Often local hunters are involved. However, in 2006 trophy hunters paid to shoot problem bears. In one case, permission was granted to shoot a female and her cubs that had killed several sheep. The local hunting club hosted trophy hunters, the female was shot but her cubs were not. According to Kassa (1995, 2003), trophies from problem bears used to be given to the public collection or museums. They are now usually kept by hunters (M. Adamec pers. comm.). This situation needs to be carefully monitored, because there has been a past history of hunters abusing the system in order to gain trophies.

Unplanned consequences of hunting

The size of bears shot in Slovakia showed a decreasing trend over the period from 1980 to 1991, though it is not clear how much of this change was due to the selective removal of large animals and how much was a result of regulations to reduce the number of large bears shot (Hell and Sabadoš 1993). In the long-term, the persistent removal of large individuals could affect the evolution of the species, because smaller individuals would have a selective advantage (Swenson 2005).

Hunted populations generally have higher recruitment rates than unhunted populations (McLellan 2005). Counter-intuitively perhaps, hunter harvest need not therefore result in fewer bears. An aspect of hunting management that might increase bear numbers is supplementary feeding, which is a widespread practice in Slovakia, even in protected areas. In the 1960-80s there were no official limits on the number or location of feeding sites (Bevilaqua in lit.). Boutin (1990), in a review of over 130 studies involving the experimental manipulation of food available to terrestrial vertebrates, found clear tendencies among individuals with access to supplemental foods: reduced home ranges, increased body weights and advanced age and timing of reproduction.

Supplementary feeding of bears by hunters might also lead to bear-human conflicts if bears become human habituated or food-conditioned. Although bears in Scandinavia appear to remain wary of humans away from feeding sites (Swenson et al. 2000), supplementary feeding with carcasses is believed to have increased the aggressiveness of bears towards humans in Slovenia (Jonozovic and Adamic 2002, Adamič 2003). Some feeding sites in Slovakia are inappropriately located as they attract bears to areas of high human use. In some cases hunters have been using food of obvious human origin, such as produce from bakeries (R. Rigg pers. obs.).

The activities of hunters (and poachers) in bear denning areas can cause bears to abandon their dens (Swenson et al. 1997b) and may also be a factor in the occurrence of motherless cubs, as disturbance can cause females to abandon their cubs (Linnell et al. 2000, Valdmann et al. 2001). Justifications given by nature conservation authorities for banning spring hunting include preventing the killing of females with dependent cubs. Records held at the SNC show that there are occasional cases of females with cubs shot during the summer-autumn hunt.

Bears have been shot accidentally during wild boar hunts (Hell and Slamečka 1999, Baláž 2003, data held by the SNC). Conversely, hunters involved in hunts for wild boar (Šebo 2004) and deer (Bevilaqua 1985, 1995) have been injured by bears.

According to Bevilaqua (1985), hunters often wound without killing bears. Injured bears are particularly dangerous (Swenson et al. 2000) and hunters are among those most frequently injured, including by wounded individuals (Šebo 2004). On 23.10.2004 a hunter was attacked by a 5-7 year old, 148 kg female whose front left leg was partially missing (from records held at the SNC). There are several cases known of bears recovering from gunshot wounds. Two of 49 bears shot in 1990 had healed gunshot wounds in their legs. A 98 kg male missing its front right leg was shot by "*regulation shooting*" on 1.10.2004. On 30.4.1982 a 3-legged bear was shot in Muránska planina Protected Landscape Area (now National Park). The bear's front left leg had been shot off by a trophy hunter c.3 years earlier, but the wound had healed well and the bear was in good condition after a long winter (Pelikán 1983).

Lobbying by hunting advocates has typically emphasised the negative aspects of bear presence. This has influenced public attitudes to bears (Wechselberger et al. 2005), which may have implications for their conservation.

3.5.3. Future perspectives

There is an intense, ongoing debate in Slovakia about future bear management policy. As has been the case virtually since the first involvement of state nature conservation authorities in bear hunting management more than 25 years ago, the discussion has been dominated by a struggle to determine the level of hunting.

Whereas hunting advocates argue that population control is necessary, some environmental activists are opposed to trophy hunting on principle. In trying to influence public opinion and official policy, extremists on both sides of the dispute have been indulging in propaganda campaigns which often include assertions that have little or no basis in scientific fact. They also risk impeding efforts to reduce bear-human conflicts in order to secure the long-term survival of bears through improved bear-human coexistence. The State Nature Conservancy has taken a pragmatic view and so has been criticised from both sides: by the hunting lobby for not allowing enough hunting and by the anti-hunting lobby for allowing too much.

Previous attempts to reach consensus or compromise having failed, there were indications in 2006 that the SNC would soon prepare its own national management plan. It was not clear who would be consulted and to what extent their views would be considered. Following a general election in 2006 a new government came to power: a coalition of populist social democratic and hard-line nationalist parties. It is too early to judge how their policies will affect bears, habitats and their management, although early indications, such as political appointments to key posts, have suggested sympathy to commercial interests. The new head of the SNC was formerly employed by the forestry service and is sympathetic to the pro-hunting lobby: in 2007 he publicly expressed support for a cull of 50% of Slovakia's bears.

New legislation

A 2006 draft²¹ of a new Hunting Act to replace no. 23/1962 maintains the status of the brown bear as a game species with year-round protection (i.e. exceptions must be issued to allow hunting) but dispenses with the old classification of "*harmful*". Hunting at night would be permitted but group hunts of this species would be expressly banned. The minimum impact energy of a weapon used for bear hunting is specified as 1,500 J at 100 m (Hell and Slamečka 1999 recommend at least 3,000 J). Compensation for damage by bears would continue to be state responsibility in hunting grounds where bear hunting had not been permitted and the responsibility of the hunting ground user if it had. The types of damage eligible for compensation would be expanded to reflect those listed in the 2002 Nature and Landscape Protection Act (see 3.6.2).

Pro-hunting lobby

Many hunting advocates (e.g. Hell and Sabadoš 1993) argue that lethal control of large carnivore populations is essential in a small country with a dense human population. There have been calls for the bear population in Slovakia to be "*urgently reduced and later on regulated*" since at least the 1980s. It has even been suggested that, if not sufficiently controlled by hunting, the bear population might continue to grow exponentially until suddenly crashing, "*in the way we know it with overpopulation of small rodents*" (Sládek in lit.).

There has been intense pressure to relax restrictions on hunting, especially to reinstate spring hunting, baiting with carcasses and quotas for larger weight categories. Those arguing for these changes believe that they would increase hunter success. In the past, quotas were not filled even when baiting with carcasses in

²¹ http://www.polovnictvo.com/modules.php?name=BiG_Forum&file=post&topic=284

spring was the most common method (Bevilaqua 1985), the main reason being that paying guests did not devote enough time to the hunt (Hell and Slamečka 1999 p.111). Spring hunting was banned on the grounds that females sometimes leave their cubs in the den while visiting bait sites (Kassa 2000b) and so might be shot, resulting in orphaned cubs in danger of starvation. This is denied by hunting advocates (e.g. Hell 2003). Although the number of motherless cubs found does not seem to have decreased since spring hunting was banned, and initially it even increased (see 3.7), there are no data available to assess if the ban has led to a reduction in the number of cubs perishing following abandonment.

In association with the call to reinstate spring hunting there have been frequent calls to end the ban on using carcasses as bait. However, as noted by Bevilaqua (1985), even when this was permitted in the past some hunters preferred other types of bait such as molasses in order to avoid problems of securing suitable carcasses, manipulation, hygiene, cleaning the bait site after the hunt and so on. EU health regulations regarding disposal of animal carcasses²² could also have a major bearing on the issue.

A second rationale for limiting hunting to summer-autumn was that this is when most damage to agriculture occurs and so, because the justification for “*regulation shooting*” is to limit damage, it should be focussed on this period (Kassa 2000b). Hunting advocates argue that damage can best be limited by reducing bear numbers, and therefore measures likely to decrease hunter success should be rescinded. Overall, patterns of reported damage are more closely correlated to the distribution of livestock than of bears. Effectiveness of preventive measures, susceptibility of some localities to conflict and individual

problem bears are other possible factors (Rigg 2004a, Rigg and Gorman 2006b). Paradoxically, even while arguing for the necessity of lethal control, some authors have noted that damage has decreased, despite increasing bear numbers (Šprocha in lit., Kováč in Burdová 2007), or was in any case “*really small*” (Bevilaqua 1985).

There are clearly financial interests involved in bear hunting. At a meeting of the Commission for Large Carnivores held on 22.2.2001 a representative of the Slovak Hunting Union, while agreeing to a trial period of autumn hunting, commented that the main motivation for spring hunting is economic (it is considered easier, more likely to be successful and so more appealing), whereas hunting in autumn is more “*sporting*” (see Pilinský 2001a).

In most cases bears are shot by paying guests. Fees are dependent on the weight of the bear and so the bigger the bear shot, the greater the income to hunt organisers. Websites of the State Forestry Service and a commercial hunting company currently list fees for shooting bears larger than the permitted weight limit (Tab. 1.11). Despite a 31% fall in the number of bears shot from 1990 to 1998, the income of state organisations from fees increased 2.5 times, becoming twice as lucrative per individual as red deer hunting (data in Hell et al. 2001 p.77). The commercialisation of hunting has been identified as a threat even to the large bear populations of Russia (Vaisfeld and Chestin 1993).

Anti-hunting lobby

Some radical environmentalists have been campaigning for a ban on “*regulation shooting*” (labelling it “*an international scandal*”), on the grounds that, “*no one knows the exact number of bears ... the social structure is disturbed ... the [shot] bears did not cause any economic damage or threaten anyone*”²³. The proposal to ban

²² <http://europa.eu/scadplus/leg/en/lvb/f81001.htm>

²³ <http://www.wolf.sk>

“*regulation shooting*” and instead allow “*protection shooting*” of all problem bears, carries with it several possible risks for long-term bear conservation:-

1. As both history and the present situation have shown, linking the granting of hunting permits with the intention to limit damage, whilst logical in theory, tends in practice to motivate would-be bear hunters to emphasise and sometimes exaggerate danger and damage resulting from bear presence and hence can actually increase, rather than decrease, conflict.

2. At certain times of year, bears descend from forested mountains to nearby fields in order to feed on maize and other crops. It would seem quite likely that if “*regulation shooting*” were banned, hunters determined to hunt bears would claim that these individuals are legitimate targets for “*protection shooting*”, because they cause damage to agriculture.

3. Whereas the number of bears shot by “*regulation shooting*” has shown a downward trend since 1992, contact between bears and humans and hence potential cases of nuisance bears can be expected to increase over the coming years with more human presence in bear habitat.

4. Many hunters not only want to be allowed to hunt bears, but are convinced that bears must be hunted to control the population and limit damage. They frequently present such arguments in the media, often to the detriment of bear-human coexistence because other viable forms of conflict resolution, such as non-lethal preventive measures, are ignored or dismissed. If commercial hunting were banned, this “*publicity campaign*” by the hunting lobby might become even more prominent and biased in its presentation of the danger and damage caused by bears.

5. Alienating the hunting community by imposing bans which they consider unnecessary, in this case even detrimental, risks triggering a substantial increase in poaching, the potential impact of which on

wildlife populations is far more serious than carefully regulated legal hunting.

6. Unnecessarily strict protection of bears could negatively influence attitudes of some interest groups towards them, particularly those who are directly affected by their presence, such as rural residents, livestock breeders, bee-keepers and so on. It is already a common complaint that “*bears are protected more than people*”.

When hunting does not seem to present an immediate threat to the bear population, and human safety and damage are sensitive issues, it is questionable if provocative campaigning against hunting is in the best interests of bear conservation (as opposed to animal rights). Some residents in bear-human conflict hotspots think that activists always take the side of the bear whatever the individual circumstances (Jób 2007). Campaigning against hunting has inflamed passions, polarised debates about conservation and coexistence and at times over-shadowed more constructive, long-term efforts in the fields of education and use of preventive measures.

Some NGOs have proposed that instead of being shot, problem bears should be caught and held in captivity or relocated. There have been several such actions in the past but the capacity, interest and suitability of captive facilities are limiting factors. Monitoring has generally been insufficient to assess outcomes of relocations. There may be objections to re-releasing known problem bears. One such attempt by environmentalist campaigners was blocked for this reason in 2001-02 (see Rigg and Baleková 2003). In general, the relocation of nuisance bears is not recommended for viable populations in Europe as it is expensive, time-consuming and, because of a lack of large wilderness areas, could lead to further problems (Linnell et al. 1997). Due to the relatively large number of bears in Slovakia and the restrictions on hunting already achieved by the State Nature Conservancy, this issue primarily concerns animal welfare.

3.6. Conflict mitigation

The conservation of large carnivores necessitates their presence in multi-use landscapes, because protected areas are too small to preserve viable populations in isolation (Linnell et al. 1996, 2005, Woodroffe et al. 2005) and activities such as tourism, forestry and hunting are common within protected areas. To achieve even an uneasy tolerance, local communities must be involved and active steps taken to help mitigate problems resulting from the presence of carnivores (Sillero-Zubiri and Laurenson 2001).

3.6.1. Non-lethal prevention

Safety in bear country

There is much high quality information available (mainly from North America) on how to minimise the likelihood of encountering or attracting bears and of being attacked. The Slovak Wildlife Society has been producing a range of educational materials in Slovak as part of *The BEARS Project*²⁴.

Relocating attractants

Shepherds have reported that moving flocks to lower altitude pastures nearer villages following attacks by predators and closing them in a barn at night has prevented further losses (Rigg 2004a). Researchers in the southwest USA found that placing beehives at least 100 metres away from forest edges and ravines reduced bear visitation by more than half (Meadows et al. 2006).

Securing attractants

Bear-proof bins were installed in several localities with human habituated and food-conditioned bears in the late 1980s (e.g. Slávik 1989), some of which are still in use (R. Rigg pers. obs.). The accounts and photographs of residents who witnessed the level of nuisance bear

activity at these locations before the bins were installed indicate that they helped to reduce the use of refuse by bears (R. Rigg pers. obs.). However, in some cases such as Demänovská dolina (Nízke Tatry) and Račková dolina (Západné Tatry) some bears continue to visit the same localities and feed on refuse despite the bins. There are at least 3 reasons for this: 1) not all refuse is secured in the bear-proof bins, other food sources continue to attract bears to the area; 2) the design of the bins results in them sometimes being left open and therefore accessible to bears; 3) some hotel staff and tourists feed bears, either to lure them closer for viewing/photographing or in the (mistaken) belief that they are helping them.

The NGOs Freedom for Animals, the Wolf Forest Protection Movement and the Slovak Wildlife Society co-operated to organise an international conference on nuisance bears in April 2002. The post-conference report and proceedings (Rigg and Baleková 2003) made several recommendations for dealing with problem bears and preventing them arising. These are listed in Appendix III along with an assessment of the extent to which they have been implemented.

The Slovak Wildlife Society began work on human habituated and food-conditioned bears in 2003-04, initially with financial support provided by WWF Denmark c/o the Danube-Carpathian Programme Office to research the issue as part of *The BEARS Project*. This was followed in 2005-08 by funding from Alertis – fund for bear and nature conservation for the project *Waste Management and Bear Conservation in Slovakia*, which included the design and installation of new bear-proof bins.

In the Polish part of the Tatra Mountains electric fences have been successfully used to stop bears feeding from hotel refuse bins (Z. Jakubiec pers. comm., F. Žieba pers. comm.).

²⁴ <http://www.medvede.sk>

Protecting livestock and beehives

Dogs are present at almost all upland sheep farms in Slovakia but the traditional and effective use of livestock guarding dogs (LGDs) is rarely seen. Instead, most guarding dogs are used in one of three ways: 1) the vast majority are permanently chained near the sheepfold or farm buildings, possibly providing some protection by barking and alerting shepherds at night; 2) some are chained during the day but released at night; 3) a few are left free to wander (Rigg 2004a).

Flocks with well-raised, free-ranging LGDs placed as part of the Slovak Wildlife Society's project *Protection of Livestock and Conservation of Large Carnivores* (PLCLC) had only one third of the reported losses to bears and wolves compared to other flocks in the same regions without such dogs (Rigg 2004a). The majority of LGDs studied showed good or acceptable patterns of behaviour and apparently had potential to become successful guardians, but only a minority were successfully integrated into flocks.

Approximately 20% of 152 sheep flocks in large carnivore range surveyed in 2003 had electric fences but in many cases it seemed to be designed to contain livestock rather than exclude predators. No significant difference was found in numbers of sheep reported lost to bears or wolves at flocks with electric fences compared to those without (Rigg 2004a).

Electric fencing can be extremely effective at preventing damage by large carnivores (see Levin 2002, Mertens et al. 2002). The shortcoming in Slovakia is that the fencing is either inadequate (does not conform to recommended parameters for predator-exclusion fencing) and/or is used incorrectly (badly set up, not live).

Electric fencing is also used to protect some beehives though, as with livestock, the fencing is not always adequate. Other methods include placing beehives on raised platforms or inside sturdy structures.

Due to their lack of knowledge and motivation to take on extra work, many shepherds refuse to use preventive measures such as livestock guarding dogs and electric fences. Even when they try to do so, alcoholism, ingrained beliefs and apathy prevent many shepherds employing them effectively. Major difficulties in working with agricultural workers were encountered throughout the duration of the PLCLC project in 2000-04 and are probably the greatest obstacle to revitalising more effective use of livestock guarding dogs in Slovakia. Other important problems are the instability and non-profitability of the agricultural sector, the concerns of hunters that free-ranging LGDs might attack game animals and interactions between dogs and farm visitors (Rigg 2004a).

Livestock guarding dogs and electric fences are both mentioned in Act no. 543/2002 on Nature and Landscape Protection (§97) among those preventive measures, the use of which is a prerequisite for the payment of compensation for damage.

Relocating problem bears

Although Kováč (2003) has claimed that 16 problem bears in Tatranský National Park were "*successfully dealt with*" in the 15 years up to 2002, monitoring has often been insufficient for objective assessment of outcomes. According to Halák (1993), some attempts were not successful. Kováč (1987) described a case from 30.4.1987, when a human food-conditioned bear was caught in the Podbanské area, where it had been fed by people at tourist facilities. However, it has been reported elsewhere that a nuisance bear returned to this area from a release site less than 20 km away and was then shot (Kováčiková 2003, Chovancová and Kozica 2006).

Halák (1993) concluded that the learned behaviour of bears which seek food near humans cannot be changed and he agreed with the recommendation of Janík (1987)

that such bears, even females with cubs, must be removed from the population.

An attempt by animal welfare and environmental campaigners to re-release a human food-conditioned female in 2001-02 was blocked by objections from local people in the proposed release area, who did not want to have a known problem bear (see Rigg and Baleková 2003). Translocation of problem bears is very rarely used in Europe due to a lack of large wilderness areas (Linnell et al. 1997).

Aversive conditioning

In some cases it is possible to deter bears from nuisance behaviour. Proven techniques include shooting with rubber bullets, electric shocks, fire crackers and chasing bears with dogs such as Laikas (Linnell et al. 2002).

Firecrackers, lamps and other simple aversive devices used in Slovakia might be helpful in some circumstances but, if they encounter them repeatedly, bears soon habituate to them (Rigg 2004a, R. Rigg pers. obs.). In some cases, bears attempting to attack livestock have been chased away by shepherds, whereas in other cases bears (and wolves) were said to be "*not afraid of anything*" and succeeded in killing sheep despite attempts to repel them. Actively repelling predators obviously depends on an attack being detected (Rigg 2004a).

There does not seem to have been any systematic attempt to evaluate the effectiveness of non-lethal projectiles such as rubber bullets on nuisance bears in Slovakia. In Austria (Rauer 2003, Rauer et al. 2003) and Poland (F. Zięba pers. comm.) there has been some success in the use of aversive conditioning on habituated individuals.

Diversionsary feeding

Some State Forestry Service employees argue that diversionsary feeding in remoter areas in spring and autumn helps keep bears away from human settlements (e.g. Halák 1993, Kováč 2003). There do not

seem to be any published data supporting this assertion. On the contrary, there have continued to be problems with nuisance bears in the High Tatras despite diversionsary feeding and elsewhere people have been injured by food-conditioned bears in areas not far from feeding sites (Rigg 2004a). In Slovenia, there seems to be an association between feeding sites and aggressiveness in bears (Jonozovic and Adamič 2002, Adamič 2003).

Currently, hunters often provide food that bears use during most of their active period, in some cases attracting them to areas of high human use (Rigg 2004a). Providing bears with more food without increasing hunting quotas can be expected to increase survival rate, reproductive success and thus population size. In the long-term, therefore, feeding might increase rather than decrease bear-human conflicts (Linnell et al. 1996).

3.6.2. Compensation

In Slovakia, the principle of paying compensation for damage caused by bears whilst protecting them from persecution (but with limited hunting) can be traced back at least 100 years, to the initiative of Prince C.K. von Hohenlohe-Oehringen in the Tatra Mountains (Hell and Slamečka 1999 p.74). The first legislation obliging the state to pay compensation for damage caused by bears arising as a consequence of their protection from hunting was enacted in 1932. In practice, the system was a token gesture because landowners still had the right to kill bears on their land until 1947 and so were not eligible for compensation, whereas hunters, who had lost the right to hunt bears, did not usually suffer any damage (Hell and Slamečka 1999 p.106).

Slovakia has had a functioning system of compensation payments for damage to livestock and beehives implemented by law since 1962. There are well-established procedures and experienced personnel for assessing damage (see Appendix V). From

1994 onwards the state has paid compensation for damage caused by bears to livestock and beehives within hunting grounds in which an exception for hunting had not been granted or that are used by state bodies. In other cases, the hunting ground user is obliged to pay compensation.

Since it came into force on 1.1.2003, the new Nature and Landscape Protection Act (no. 543/2002) extended compensation to cover other forms of damage, including the *“lives and health of natural persons”, “dogs used for guarding”, “not harvested crops” and “hoofed game in areas with a year-round protection of defined animals”* (§97 par. 1). According to official records from Banská Bystrica district, finances were not made available for these additional payments in 2003 and so in reality the new conditions did not begin to operate until 2004.

Act 543/2002 makes the payment of compensation conditional on the use of preventive measures: enclosures, electric fences, guardians and shepherd dogs are mentioned specifically (§98). In previous legislation it was stated only generally that compensation would be paid if damage was judged by an official commission to have occurred without fault of the owner or guardian. However, even in the new legislation, relatively ineffective actions, such as chaining up dogs near sheep at night, are accepted as sufficient.

Hell et al. (2005) stated that slightly over half claimed damage is compensated. Figures presented at a meeting of the Commission for Large Carnivores on 19.3.2002 by a representative from the Forestry and Hunting Management section of the Agriculture Ministry (Hlásnik 2002) also gave this impression. However, these sources do not agree with SNC records (Kassa 1999a, 2001b, 2002b), which show that compensation paid for damage attributed to bears in 1998-2002 varied from 90% to 59% (mean = 72%) of reported damage to livestock and beehives

(data in Šebo 2003), although the general trend was downward. In 1973-78, 69% of claimed damage was compensated (from data in Sabadoš and Šimiak 1981).

A representative of the Association of Sheep Breeders participating at the 22.2.2001 meeting of the Commission for Large Carnivores complained that the process of paying compensation was too slow and ineffective (Pilinský 2001a). Allegedly, procedures are so demanding in terms of time and costs that in many cases those who have suffered damage do not try to claim compensation they are entitled to. According to the Nature and Landscape Protection Act, compensation must be paid within 4 months of a valid application (§101 par. 3). A further complaint was that payments sometimes do not reflect the actual level of damage. The Act states that, *“Damage to property shall be compensated according to real damage.”* (§99 par. 4).

On the other hand, damage assessment personnel have noted that damage is sometimes reported up to a month after it occurred, which may make an objective assessment of its cause impossible. The difficulty of verifying damage is one of several intrinsic problems of any compensation scheme (Nyhus et al. 2005). The Nature and Landscape Protection Act requires claimants to report property damage in writing within 48 hours of its discovery (§100 par. 1).

For a compensation scheme to be effective at fostering greater tolerance of bears, the public must be aware that it exists. In 2003-04 this was not usually the case (Wechselberger et al. 2005). In 2007, in a community well-known for having relatively frequent problems with bears, more than half of residents surveyed did not know that damage is compensated (Jób 2007). Despite the 45-year existence of a compensation programme, farmers and shepherds still tend to have the most negative attitudes and be in favour of more lethal control (Wechselberger et al. 2005).

3.6.3. Lethal control

Humans have been killing bears and other wildlife species perceived as threatening their food sources or safety for thousands of years, presumably since such situations have arisen. Lethal control of stock raiders is common in all cultures and has had devastating impacts on large carnivore populations (Woodroffe et al. 2005). Retaliatory killing was the most important reason for the historical decline of large carnivores across large parts of their original ranges (Breitenmoser 1998).

The principle of citizens being permitted to kill marauding bears to prevent damage has been included in laws valid within the territory of present-day Slovakia since the 18th century, when a regulation was passed that permitted landowners and users to kill unlimited numbers of bears as well as other animals that caused damage to livestock or crops (Halák 1993). This right was not rescinded until 1947.

Following population recovery, sport hunting was resumed, according to Janík (1997) because, “...damage caused by bears to sheep, beehives and especially cattle was prevalent”. This author stated that preference for removing problem bears was introduced from 1980. However, according to other sources (e.g. Šprocha 1977) it was one of the aims of hunting management since legal trophy hunting began in 1958-62. For example, it was proposed to allow the shooting of 43 bears in 1976, 25 of which (58%) were to be problem bears (Dubovský in lit.).

Currently, removal of nuisance bears, known as “*protection shooting*”, is one of two forms of legal bear hunting operating in Slovakia. Official procedures for assessing applications to remove problem bears are outlined in Appendix V. The other system of hunting, “*regulation shooting*”, is also connected to conflict mitigation, as it is assumed that damage caused by bears can be maintained at

acceptable levels by limiting the bear population number and density.

There does not seem to have been any scientific assessment of the effectiveness of lethal control as a technique to reduce damage and/or conflict in Slovakia. Linking not only the removal of problem individuals but also trophy hunting to the occurrence of damage has led to hunting advocates and applicants for hunting permits emphasising and sometimes exaggerating danger and damage caused by bears to support their cases. In an extreme example, a hunting organisation applying for permission to conduct bear hunting in Liptov cited the injury of a mushroom picker by a bear reacting defensively to a sudden encounter as demonstrating the need to kill 3 bears in order to reduce local population density. In their application, the hunting organisation admitted that no damage had occurred to livestock or property in the area, and even stated that this was due to the use of preventive measures, but argued that, “*numbers of bears are increasing year on year, old individuals displace the young.*” The application was upheld.

The regional allocation of the hunting quota in 2000-02 was correlated more strongly to the estimated distribution of the bear population than to that of compensation payments in 1999-2001 (compare Figs. 3.7a-c). In particular, Banská Bystrica (BB) stands out as having had a disproportionately high share of the quota (29.2%) compared to compensation payments (10.6%). There has been a high rate of hunting in the Banská Bystrica region since at least the 1980s (see Hell and Sabadoš 1993), presumably related to high bear density in this area but perhaps also to the traditional focus of the State Forestry Service. The proportion of the quota allocated to Zvolen (ZV) and Martin (MT) was also higher than the proportion of compensation in these 2 regions and Topoľčany (TO) had 2.8% of the hunting quota in 2000-02 despite a lack of any

compensation payments in 1999-2001. In several cases in northern Slovakia, permission was granted to hunt bears despite a lack of damage, on the basis of local bear numbers as estimated by the hunters applying for permission.

On the other hand, Dolný Kubín (DK), Poprad (PP) and Rožňava (RV) had much lower shares of the hunting quota than would be expected if it was distributed solely on the basis of damage.

From the data available it is difficult to draw firm conclusions of cause and effect. The high hunting quota in Banská Bystrica may or may not have limited population growth (see 1.1.6) and/or damage.

Tab. 3.4. Regional distribution of bears and hunting quotas (number and percentage of total) in 2000-02 and compensation payments (in Slovak crowns and percentage of total) in 1999-2001. Compiled from data in Kassa 2001a,b, 2002a,b, 2006, Kaštner 2004, State Nature Conservancy records.

Region	Bears	Compensation		Quota	
	%	SKK	%	n	%
BB	19.0	210,758	10.6	62	29.2
BJ	<0.1				
CA	1.7	46,784	2.4	1	0.5
DK	5.9	419,299	21.1	17	8.0
HE	1.8				
KS	0.2				
LC	2.5	28,166	1.4	3	1.4
LM	18.9	421,017	21.2	31	14.6
MT	10.7	84,485	4.3	23	10.8
PB	2.5	47,000	2.4	3	1.4
PD	4.8	129,192	6.5	14	6.6
PO	<0.1				
PP	5.5	157,348	7.9	1	0.5
RS	5.8	176,068	8.9	9	4.2
RV	2.6	104,928	5.3	2	0.9
SK	<0.1				
SL	<0.1				
SN	1.0	770	<0.1	2	0.9
TO	1.0			6	2.8
ZA	6.0	37,300	1.9	7	3.3
ZH	4.2	59,935	3.0	9	4.2
ZV	5.5	61,507	3.1	22	10.4
Total		1,984,557		212	

Fig. 3.7a. Relation of regional distribution of compensation payments to bear population. Sources: see Tab. 3.4.

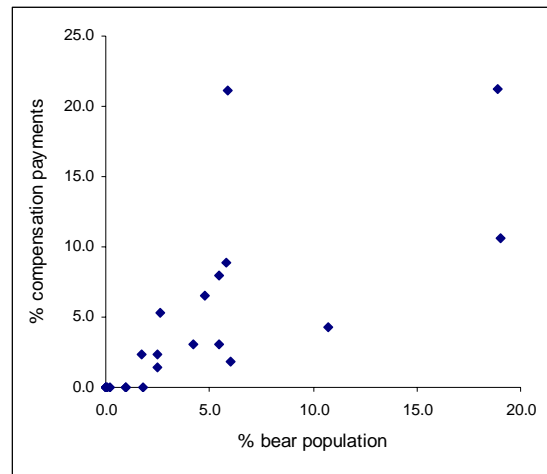


Fig. 3.7b. Relation of regional distribution of hunting quota to bear population. Sources: see Tab. 3.4.

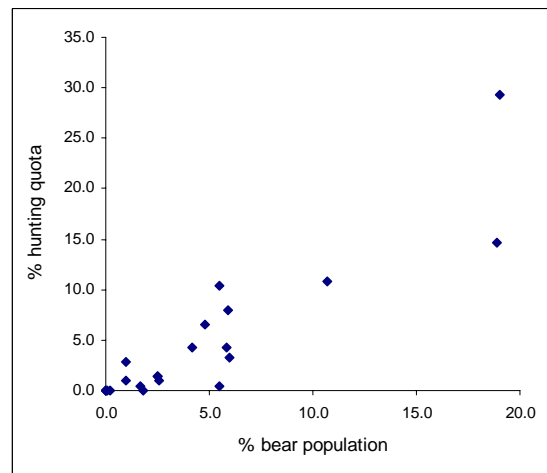
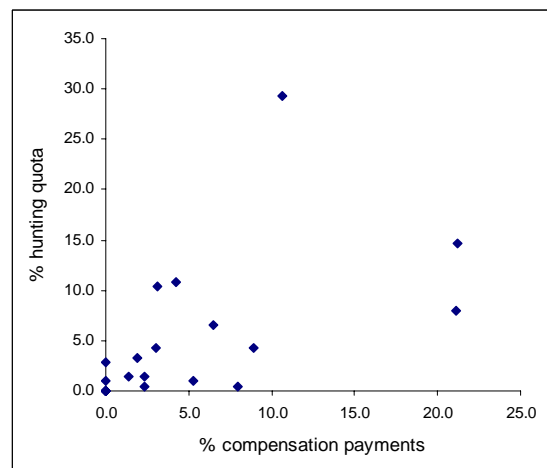


Fig. 3.7c. Relation of regional distribution of hunting quota to compensation payments. Sources: see Tab. 3.4.



Many hunting advocates often go beyond arguing that there is a need to limit population growth and call for a cull, claiming that 300-500 individuals is a “tolerable number” and 350-400 the “optimal number” of bears in Slovakia. To reduce the population to this size would require a c.37-63% reduction in present numbers, violating published Natura 2000 criteria for favourable conservation status.

The few studies on lethal control of bears elsewhere suggest that selective removal of problem animals (equivalent to Slovakia’s “protection shooting”) can prevent further damage but, if attractants are not removed or secured, the effects may be short-term due to recolonisation by other individuals (reviewed in Treves and Naughton-Treves 2005). In the Hrebienok area of the High Tatras, a 90 kg female that had been feeding on refuse (and was hand-fed by tourists) during the previous 3 years was shot in 1987, but by 1.2.1988 a different bear had already begun doing the same thing. Bears are still visiting the same localities 20 years later.

Treves and Naughton-Treves (2005) suggested that public hunts (equivalent to Slovakia’s “regulation shooting”) are probably not as effective at preventing damage. It would seem that only by chance could the shooting of a random individual (size categories excepted), up to a year after damage has occurred, prevent future damage. In some years, low availability of natural food sources may lead to higher than average damage in some areas. This situation cannot be influenced by hunting in the following year, when circumstances are likely to have already changed.

Nevertheless, Treves and Naughton-Treves (2005) argued that, by empowering those affected by carnivores, public hunts might improve tolerance of carnivore presence in multi-use landscapes more than selective removal, although they may be unacceptable to some sections of society, particularly urban residents.

3.6.4. Other aspects

The mitigation of conflict is not only a question of preventing or reducing actual danger and damage. As social, cultural and psychological aspects are also involved, reactions to the same level of economic loss differ among individuals and groups of people. There is often a difference between real and perceived damage and danger. People might be more willing to tolerate certain levels of damage, risk and inconvenience if they are perceived to be within acceptable limits or are off-set by benefits such as a share of revenue from hunting or wildlife tourism.

In light of the above, education and awareness have important roles to play. Recently there has been a sustained campaign by the hunting lobby in Slovakia to allow more hunting, as justification for which bear-human conflicts have often been highlighted without mentioning possible preventive measures, existence of a compensation scheme and provisions for the removal of problem bears.

Fear is an important factor in attitudes to large carnivores (Wechselberger et al. 2005). Bears feeding on refuse may cause little damage but their presence leads to potentially dangerous situations and influences people’s general perception of bears. It is a common, although perhaps unjustified, complaint that for some conservationists bears are more important than people. The hard-line anti-hunting approach taken by some Slovak NGOs in recent years has probably encouraged this impression. Understandably, people want their concerns to be taken seriously.

Establishment of a Bear Emergency Team, allowing quicker and more effective responses to problematic situations, could help to reassure the public. There is good experience in Austria and Poland. To some extent, separating management of trophy hunting from damage prevention might help reduce the volume of misleading pro-hunting propaganda.

3.7. Bears in captivity

Entertainment

“Dancing bears” were still kept by Roma in Slovakia in the early 20th century (see Hála 1942 p.36-39) but this practice has died out. Some circuses in Central Europe include bears (see Rogner 2003). In the 1960s, a young bear caught in spring was kept in a cage at a tourist resort in Slovenský ráj. After escaping several times and injuring a tourist it was shot (Teren 1987 p.87-88). Keeping bears in such conditions is now outlawed.

Zoos

Several zoos in Slovakia keep and breed bears: Bojnice, Bratislava, Košice and Spišská Nová Ves. Until recently Stropkov Zoo kept bears in extremely cramped conditions. In January 2002, a 5-cub litter was born in Košice Zoo, despite the male supposedly having been castrated in the previous April. At the time, this was considered a record number of cubs born in captivity. (Pazetnov and Pazetnov 2005 subsequently documented a litter of 6 cubs taken from the wild in European Russia.)

Motherless cubs

It is illegal to remove bears and other protected species from the wild, but well-meaning members of the public, hunters and foresters still do so. “Abandoned” or “orphaned” bear cubs are discovered in Slovakia in most years, usually in late April or early May (Tabs. 3.5 and 3.6). Motherless cubs are common in several other countries. In Estonia, it is believed that most are the result of the female being disturbed at her den by hunters/foresters (Valdmann et al. 2001). At least 10 cubs were abandoned in Croatia in winter 1987-88 (Dečak et al. 20005). Some cubs are orphaned due to natural causes, such as when an avalanche in the Tatras killed a mother bear in 1947 (Teren 1987b).

One of the reasons for banning spring hunting in Slovakia was to reduce the risk of shooting females that had left their

dependent cubs at the den while visiting bait sites. It is recorded in the minutes of the 22.2.2001 meeting of the Commission for Large Carnivores (Pilinský 2001a) that in the first year of the ban (2000) Bojnice Zoo received more than twice as many requests to home motherless cubs as in preceding years.

Tab. 3.5. Number and fate of motherless cubs taken into captivity in 1995-2007. Data may be incomplete. Sources: see Tab. 3.6.

	Released	Zoo	Other	Total
1995		2		2
1996				
1997				
1998				
1999		1		1
2000	1	1	1 ^a	3
2001		3		3
2002		1		1
2003		1		1
2004				
2005	1			1
2006	1	1		2
2007	2	2		4
Total	5	12	1	18

^a Escaped.

Attempts to reunite young cubs with their mothers have had mixed results. Monitoring has usually been insufficient to assess outcomes of releasing cubs to the wild (Tab. 3.6). It was thought that a cub of the year released in Nízke Tatry National Park on 3.6.2000 might have survived alone because it was able to find food for itself (Ondruš 2000), but it was not marked or seen subsequently. Another cub escaped in mid-November of the same year, having been held in captivity since early May (Hapl and Uhrin 2000).

It is known from studies elsewhere that some bear cubs survive in the wild after being orphaned at ages greater than 5 months (Beecham and Watkins 2005). In Russia it has been observed that the basis of feeding behaviour is formed at 4-5 months of age, with subsequent learning, while den construction is largely innate

behaviour (Pazhetnov 2005). Cubs of the year have survived well without their mothers in Scandinavia from the beginning of July. With supplementary feeding, a male cub abandoned in early May survived in the wild until he was shot as a 4 year old weighing c.180 kg (Swenson et al. 1998a).

Tab. 3.6. Examples of motherless cubs found, management actions taken and outcomes, if known.

Date found	Locality	n sex	Actions and outcomes	Sources
1995	Veľká Fatra NP	2M		SNC
Spring 1999	Malužinská dolina, Nízke Tatry NP	1M	Taken to Bojnice Zoo.	Krchniak 2001
4.2000	Ludárová dolina, Nízke Tatry NP	1	Held in captivity for 8 days; from 8.5.2000 kept in cage in forest and fed. Weight more than doubled before released on 3.6.2000.	Ondruš 2000
1.5.2000	Suchá dolina/Muráň, Muránska planina NP	1M	Attempt to reunite with female unsuccessful, rejected by zoo (wanted female). Kept in small enclosure. Escaped in November.	Uhrin 2000, Hapl and Uhrin 2000
2.5.2000	Tatranská Javorina, Tatranský NP	1F	Zoos initially uninterested. Raised in small enclosure until taken to Bojnice Zoo on 26.6.2000.	Slivinský 2001
20.4.2001	Lehota pod Vtáčnikom, Ponitrie PLA	2M,1F	3 cubs all taken to Bojnice Zoo.	SNC, Kassa 2002a
2002	Muránska planina NP	1M		SNC
5.2003	Čutkovská dolina, Veľká Fatra NP	1F	Taken to Bojnice Zoo.	press reports
2005	Korytarky, Poľana PLA	1		SNC
18.3.2006	Párnica-Zázrivá, Malá Fatra NP	1F	Fed by NP staff before being taken to Bojnice Zoo on 20.3.06.	press reports
Spring 2006	Hriňová, Poľana PLA	1	Was offered to zoos but none wanted so was fed and released.	press reports, SNC
26.2.2007	Štiavnické vrchy PLA	1	Probably taken from den. After 3 months in rehabilitation centre taken Bojnice Zoo.	SNC
29.3.2007	Horný Jelenec, Veľká Fatra NP	1	Considered attempt at adoption in wild but taken to Bojnice Zoo.	press reports, SNC
16.4.2007	Dolný Jelenec, Veľká Fatra NP	1	Found near forest fire; released after 3 days in area where female seen.	press reports, SNC
5.5.2007	Horný Jelenec, Veľká Fatra NP	1	Found on house roof near forest. Released immediately but next day returned. Released again after 2 weeks.	SNC



The Arcturos bear sanctuary and education facility in Greece, one of several such centres in Europe.

The SNC has in the past rejected proposals from NGOs to build a bear sanctuary in Slovakia, even though public education about bears would have been one of the aims (see Urban 2001). The SNC also stopped the establishment of a centre for the re-release of bear cubs to the wild that was to be based on the rehabilitation work of V. Pažetnov (1985) due to the failure of those involved to obtain the permission required to build in a National Park (see Hapl and Uhrin 2000).

Where abandoned bear cubs are to remain in captivity, the SNC has given preference to housing them in Bojnice Zoo or other zoos in Slovakia or abroad (Urban 2001). The capacity of such establishments is, however, limited and they have sometimes rejected particular individuals on the basis of sex (Uhrin 2000).

Establishment of a bear rehabilitation and/or refuge centre could have enormous benefits. Although its capacity might be

quickly filled if animals were kept permanently, its greatest potential benefit would be in raising awareness about the need to protect wild carnivores and their natural habitats. There is evidently great interest from the public in seeing orphaned bear cubs, so much so that it has threatened the success of previous attempts to re-release cubs to the wild (cf. Ondruš 2000, Uhrin 2000). However, if divided into sections with different levels of access, a specialised captive facility could temporarily house abandoned cubs before re-release while educating the public through an associated education centre and permanently resident bears. There are already bear refuges and/or large carnivore education centres in several European countries, including Austria, Bulgaria, Croatia, Finland, Greece, Holland, Hungary, Italy and, most recently, Romania, which could provide valuable know-how in setting up similar facilities in Slovakia.

3.8. Research

The literature on bears in Slovakia is dominated by game management. Much of what has been published or presented contains insufficient data or analysis to be considered more than anecdotal evidence and is prone to subjective interpretation. There has been a marked shortage of objective scientific research, particularly using modern methods such as telemetry and non-invasive sampling for genetic analysis. Far more research has been done on the ecology of bears in Poland, some of which have home ranges partly in Slovakia (Zięba and Kozica 2005).

Population monitoring

According to Janík (1997), annual population estimates have been conducted by qualified forestry employees since 1963. The results of this game census, compiled at Zvolen Forestry Research Institute, are widely criticised as highly inaccurate when added together for the purposes of obtaining total, national population estimates. Besides a high potential for counting the same individuals in two or more hunting grounds, other weaknesses of the system are that the methodology is not clearly described or standardised and there is no independent control of data quality or accuracy.

However, the census does give a quite reliable indication of presence/absence. In addition, as the methodology used is probably fairly consistent, it can be used with a reasonable degree of confidence to examine population trend over time or compare different geographic areas.

Hell and Sabadoš (1993) assessed the results of hunting management in 1980-91 by examining the geographical distribution of shot bears, their size, sex and numbers, including a comparison of trend over time. The age-sex structure of the bear population in the West Carpathians was evaluated in 1977 (Sabadoš and Šimiak 1981) and 1992 (Hell and Sabadoš 1995). As these authors noted, in the absence of

telemetry studies there are no reliable data from Slovakia on important parameters such as sex ratio, age of first litter and mean inter-birth interval.

Various authors have examined body measurements of shot bears. Sládek (1992) investigated the possibility to distinguish the sex and age of shot bears by skull and teeth measurements. Hell and Sládek (1994) determined a regression equation between paw size and body weight that has been used for monitoring as well as hunting management by tracking. However, Halák (1993) thought that track counts can offer only supplementary information because he found that bears with the same length of hind foot could vary considerably in weight: e.g. 2 shot bears with hind feet 23 cm long weighed 87 kg and 160 kg while 3 bears with hind feet 24-25 cm long weighed 73 kg, 147 kg and 240 kg. He concluded that the best way to estimate bear numbers is to search for den sites and monitor them as bears emerge in spring.

Besides the annual census of game species conducted by foresters and hunters, monitoring of selected endangered species, including the brown bear, is or has been conducted to varying degrees within several protected areas, including Poľana Protected Landscape Area and Tatranský, Nízke Tatry, Malá Fatra, Veľká Fatra, Slovenský raj and Poloniny National Parks.

Genetics

Hartl and Hell (1994) investigated genetic variation among bears in the West Carpathians. At least 3 studies conducted by researchers based in other countries have included small numbers of samples (up to $n = 12$) obtained from bears in Slovakia. For the 2 older studies (Taberlet and Bouvet 1994, Kohn et al. 1995), P. Hell of Zvolen Forestry Research Institute supplied samples from shot bears, whereas for the most recent study (Paunović and Čirović 2006), R. Rigg of the Slovak

Wildlife Society used non-invasive sampling of hair and scats. For a study by researchers at Zvolen Technical University (Paule et al. 2006), tissue samples have been taken from shot bears since 2004 and in 2007 non-invasive sampling was also begun.

Ecology

Studies using telemetry and genetics have begun only recently, so knowledge of home range size, activity and movements is very limited. Jamnický (1976, 1987) studied bear rub trees and other forms of intraspecific communication, but his conclusions are somewhat limited and prone to subjective interpretation because he was not able to identify the sex or age of individuals leaving marks, which he assumed were all males.

Several other authors have offered mostly qualitative observations of bear natural history (e.g. Halák 1993).

Three separate studies have presented quantitative results on diet, all from northern Slovakia. Two of them (Jamnický 1988b, Baláž 2002) have several methodological shortcomings. Neither they nor the most recent study (Rigg 2004a, Rigg and Gorman 2006a) attempted to measure food availability and so little if any assessment can be made of selection and preference. Steyaert (2006) has investigated the role of brown bears in seed dispersal. A quantitative study on the selection of herb species by a female bear and her 3 cubs has been conducted by feeding site surveys on the Polish side of the Tatra Mountains (Jakubiec et al. 2003).

Žilinčár et al. (1992) and Čelechovská et al. (2006) studied heavy metal pollutants in bear tissues. There have also been studies on endoparasites (Mituch 1972, Goldová et al. 2003) and mycobacterial infections (Kopečna et al. 2006).

There is a clear need for research on the ecology of bears in Slovakia which would help managers to prioritise actions for bear

conservation in the face of habitat loss, degradation and fragmentation. More reliable data are needed on home range, activity and movements as well as diet, habitat use and selection. This would not only assist managers who need to mitigate bear-human conflicts and set (as well as justify) hunting quotas but might also, through education and understanding, foster greater tolerance and encourage the use of appropriate non-lethal preventive measures to limit damage and danger.

Bear-human conflicts

Due to the existence of compensation payments since 1962, there are relatively good records of damage claims. The amount of compensation paid, what the damage was and in which administrative districts it occurred have been summarised and published in some years by the SNC (Kassa 1999a, 2001b, 2002b). Statistics compiled at Zvolen Forestry Research Institute on the basis of the annual game census record damage allegedly caused by large carnivores but, unlike in the case of compensation payments, such reports have not necessarily been verified by a damage inspection commission and hence are less reliable.

Patterns of predation on livestock and the effectiveness of certain forms of non-lethal preventive measures were investigated by Rigg (2004a, 2005a).

Human dimensions

Wechselberger et al. (2005) conducted a questionnaire survey of public opinion, knowledge and attitudes towards bears, wolves and lynx as well as their conservation and hunting management in Slovakia in 2003-04. The study identified what most influenced levels of acceptance, for example socio-demographic factors, level of fear, knowledge, previous experience of large carnivores and perception of population size as well as carnivore species and local abundance. Jób (2007) used a similar questionnaire.

3.9. Education

All National Parks now have education officers among their staff. Some of them have included bear-related topics among their activities. Other state bodies, such as the Slovak Environmental Agency, also run environmental education programmes.

The Slovak Wildlife Society's *BEARS Project – Bear Education, Awareness and Research in Slovakia* – aims to:-

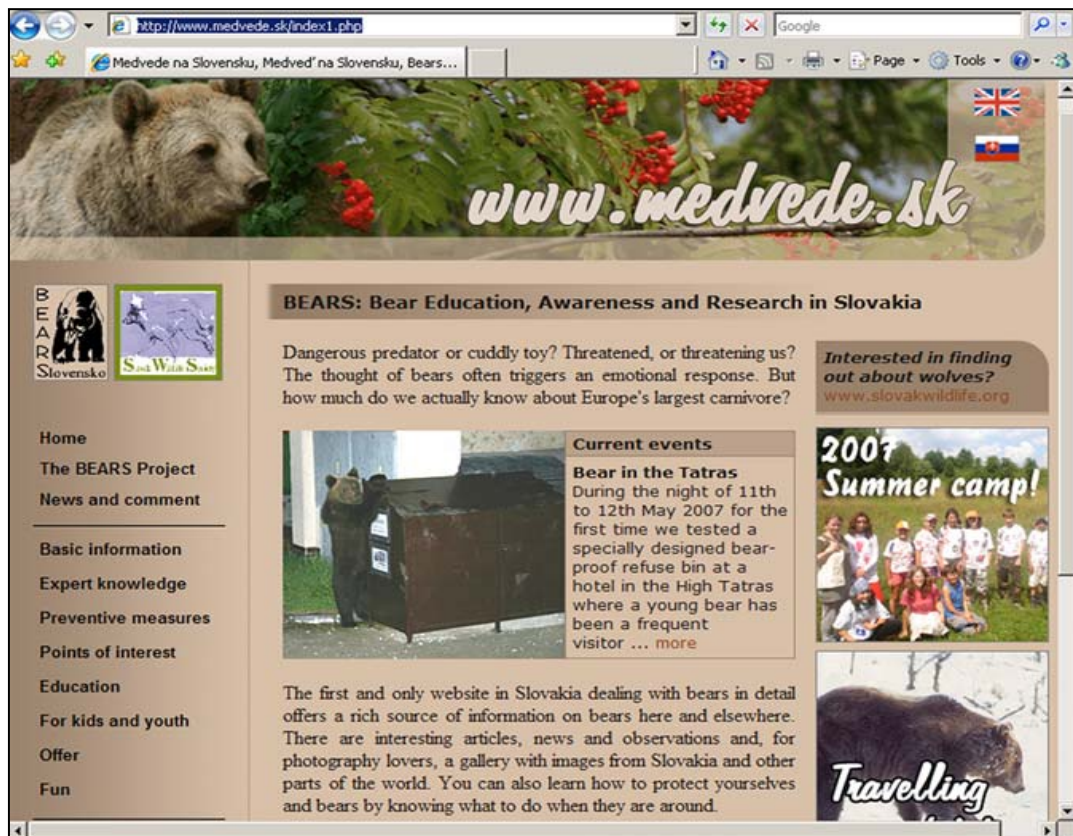
- Foster greater tolerance and understanding of bears in Slovakia;
- Raise public awareness and knowledge of bears and bear safety;
- Test, implement and promote the use of non-lethal preventive measures;
- Provide the best available information based on scientific research;
- Encourage children and youth to take an active interest in nature;
- Contribute to the scientific understanding of bears;
- Improve the quality of data available to managers;

- Support bear conservation and habitat protection.

The project began in 2003 with a survey of public opinion, attitudes and knowledge which found mainly neutral to positive attitudes towards bears but low levels of knowledge. Many people considered a lack of information to be the most important problem in bear management. More than 90% of survey respondents wanted to learn more about large carnivores.

Survey results were used to design an education programme within *The BEARS Project* with activities such as maintaining a project website, liaising regularly with journalists and producing manuals for teachers, a travelling exhibition, a DVD/VHS and materials for children.

Education initiatives are limited by the amount and quality of information available. This is a major issue regarding bears in Slovakia due to the paucity of scientific research on bears in the country. This vacuum has tended to be filled by myth, speculation and misinformation, especially by hunting-related propaganda.



Summary and evaluation of management

A wide range of measures have been implemented to ensure that the bear population continues to prosper. Hunting, once a major factor in the demise of the bear, is strictly limited. At its present level it is unlikely to cause population decline or even prevent further increase in numbers. Current hunting management is a compromise between conservation and allowing a sustainable harvest by trophy hunters. A precautionary principle is used when estimating population size and setting quotas, in which all known mortality is considered. Strict criteria have been set, at the expense of hunting success, to limit negative impacts of trophy hunting. The proportion of the annual hunting quota that is filled has shown a downward trend since 1991-92.

The strategy adopted to limit damage is based broadly on the 3 elements described by Boitani (2003) as, “*the most rational and effective approach*”: use of preventive measures, payment of compensation for damage and elimination of problem individuals.

The intrinsic conflict between the goals of conservation authorities and those of trophy hunters, and the belief of many hunting advocates that lethal control of bears is essential, has resulted in intense pressure by the hunting lobby to relax restrictions. In recent years there has been a highly visible campaign in the media by hunting advocates claiming that bear-human conflicts are due to bears being “*overpopulated*” and promoting increased trophy hunting as a cure-all solution.

Managers lack data to refine and justify policies due to an almost complete lack of rigorous modern research. There does not appear to have been an objective study of the extent to which hunting reduces damage and danger to humans. The policy of concentrating hunting in areas where bears have caused damage or threatened

human safety has sometimes led to increased conflicts, because hunters are motivated to amalgamate “evidence” of threats posed by bears in support of their hunting applications. An over-emphasis on lethal control has been to the detriment of more effective prevention measures, the cost of which might be partially offset by a reduction in compensation costs.

There are several other problems with implementation of the current management system. Whereas compensation is usually paid by the state, hunting ground users that receive a permit for bear hunting become liable to pay compensation for any damage caused by bears in their hunting ground in that year. This might deter some hunting ground users from applying to hunt bears where they believe there is likely to be damage but are not confident that a hunt would be successful. Excluding hunting from protected areas and focussing it on localities with higher risk of bear-human conflict, whilst reasonable in principle, in some cases appears to result in the luring of bears to baits placed near areas of higher human use, thus increasing rather than decreasing the risk of conflict (even if a bear is shot, others may also be attracted to the bait and remain in the area).

By continually focussing debate on population size, hunting quotas and regulations, both pro- and anti-hunting lobbies have drawn attention away from potentially more important issues. Loss, fragmentation and degradation of habitat are likely to be important in the mid- to long-term. Although a substantial protected area network has already been established, it has not prevented major development in and fragmentation of habitats. Connection of the West and East Carpathian sub-populations of bears appears to be tenuous and is not fully safeguarded by proposed Natura 2000 networks in Slovakia or Poland.



CONCLUSIONS AND RECOMMENDATIONS

From having been almost exterminated 75 years ago by hunting and persecution, legal protection has allowed bears in the West Carpathians to recover naturally. Numbers still seem to be increasing despite limited hunting since 1958. The current size and trend of the population suggest that it is in little short-term danger. However, socio-economic changes are bringing new and growing threats while conflicting approaches to management have resulted in failure to implement important conservation recommendations.

A national brown bear management plan has yet to be established, despite repeated calls by the Standing Committee of the Bern Convention and the Council of Europe. There has been little meaningful cooperation with neighbouring states sharing the same bear population (Czech Republic, Poland, Ukraine) and so consideration of management at population level, also emphasised by international experts, has been inadequate.

Important recommendations in the Council of Europe's *Action Plan for the Conservation of the Brown Bear in Europe* have not been implemented satisfactorily:-

- *Establishment of national brown bear management groups and plans (countries sharing populations produce management plans co-operatively);*
- *Evaluation of impact of existing and planned infrastructure on bear habitat and mitigation of negative impact;*
- *Minimise creation of problem bears;*
- *Co-ordinated scientific research.*

Loss, fragmentation and disturbance of habitat are potentially major threats to wildlife in the Carpathian Mountains. Adequate steps need to be taken to prevent permanent isolation of habitat and wildlife, including bears.

Reliable data is a basic requirement not only of effective conservation and hunting management but also to inform the public and key stakeholders. Very little modern scientific research has been done on brown bears in Slovakia. Improved monitoring of population size, trend and structure is a particular priority. Research on ecology is also very important to allow better understanding of the needs of bears as well as the causes of bear-human conflicts. Habitat use, social organisation and dispersal are especially pertinent.

Gaps in knowledge left by the lack of research have been filled by untested theories, speculation and misinformation originating from biased views of lobbyists. There has been sustained campaigning by hunting advocates to allow more hunting, as justification for which bear-human conflicts have been highlighted and exaggerated, often ignoring existing mitigation measures such as a compensation scheme, provisions for the removal of problem bears and possible non-lethal preventive measures.

Those participating in bear hunting clearly do so for a variety of reasons, not just to decrease danger to humans and damage to agriculture. Some motivations, especially the desire to obtain medal-winning trophies and income from paying guests, have frequently conflicted with management goals of maintaining a close to natural population structure and focussing hunting on removing the most troublesome, rather than the largest, bears.

Policies implemented by the State Nature Conservancy since 1994 generally represent reasonable compromise between the goals of conservation versus trophy hunting and there would appear to be little threat to the bear population from recent harvest levels. Nevertheless, history has

shown that there is a clear need for strict regulation of hunting.

On the other hand, objections by radical animal rights and environmentalist groups opposed to hunting on principle have maintained the focus of public debate on wrangling about population size and quotas, over-shadowing efforts to achieve broad-based consensus through addressing the challenges of bear-human coexistence.

Disengaging management of trophy hunting from damage prevention might help to reduce the mistaken perception that lethal control is the only solution to bear-human conflicts. One possible approach would be to use improved methods of population monitoring to set sustainable quotas for trophy hunting in broad-scale zones (such as the core area of the range or where bear presence is regarded as undesirable). Individual permits could then be issued to applicants on a rotational or random basis, not conditional on levels of damage.

Bear-human conflicts (both real and perceived) must be adequately addressed. Establishing a Bear Emergency Team could help to assuage public fears by allowing quicker and more effective interventions whilst showing that concerns are taken seriously and “something is being done”.

“Protection shooting” (or live capture) should continue to be used to remove specific problem individuals from the population. However, a much greater emphasis should be placed on eliminating the causes of nuisance behaviour, such as improperly stored food or refuse, unprotected beehives in forested areas and so on. There is considerable scope for more use of electric fences, livestock guarding dogs, bear-proof bins and basic precautions to avoid encountering or attracting bears. Educators should focus on raising awareness of these measures.

Within the context of conflict reduction it is important to realise that, contrary to

the frequent claims of pro-hunting advocates, damage levels in recent years have been much lower than in the past, when the bear population was much smaller than at present and there were fewer restrictions on hunting. There is also evidence to suggest that attacks on humans are less frequent now than in the 1980s.

Farmers and shepherds still tend to have the most negative attitudes to bears despite the availability from 1962 of compensation for livestock losses. This situation might be alleviated by simplifying bureaucratic procedures and expanding the scheme to include payments for lost production rather than merely replacement value. There is a growing body of evidence indicating that a substantial proportion of conflicts occur at a relatively small number of predisposed localities or types of locality. Improved research and monitoring could help identify damage “hot spots”, where investment in preventive measures might be offset by helping to reduce the cost of compensation. Other possibilities include subsidising insurance cover, making proactive payments on the basis of carnivore presence rather than refunding damage and providing replacement animals.

To summarise, maintaining the brown bear at a favourable conservation status in the face of growing pressures from development in Slovakia is likely to require the following actions:-

- adequately protecting core habitats;
- identifying, maintaining and improving movement corridors and linkages;
- tolerating bear presence in some areas beyond core habitats;
- continuing to regulate hunting strictly;
- placing less reliance on lethal control and more on using preventive measures;
- carefully monitoring population trends;
- conducting more research on bear ecology and key population parameters;
- providing accurate information in wide-reaching, credible education initiatives.

REFERENCES

(If an English title was given in the original work, it has been reproduced here, even if it contains incorrect spelling, grammar or translation. All websites listed in the references as well as in footnotes to the main text were online in January 2007.)

- Adamec M., Rajtar R. and Urban P. (2005). Rozšírenie, stav a ochrana veľkých šeliem na Slovensku. (Distribution, status and conservation of large carnivores in Slovakia.) In: *Zborník referátov z medzinárodnej konferencie Levice, 12.03.2005*. Výskumný ústav živočíšnej výroby, Nitra: 63-72. (in Slovak.)
- Adamič M. (1997). The expanding brown bear population of Slovenia: a chance for bear recovery in the southeastern Alps. *Int. Conf. Bear Res. and Manage.* **9(2)**: 25-29.
- Adamič M. (2003). The brown bear in Slovenia: a brief summary of the 20th century population dynamics and future conservation issues. In: *Living with bears: a large carnivore in a shrinking world*. Kryštufek B., Flajšman B. and Griffiths H.I. eds. Ecological Forum LDS, Ljubljana: 157-171.
- Anon (2005). *Management and action plan for the bear population in Romania*. Ministry of Agriculture, Forestry and Rural Development and Ministry of Environment and Water Management, Bucharest. 79 pp.
- Baláž E. (2002). *Ekológia medveďa hnedého (Ursus arctos L.) v Západných Tatrách a na Poľane*. (The ecology of the brown bear (*Ursus arctos* L.) in the Western Tatras and in Poľana.) Masters thesis. Technická univerzita vo Zvolene. 55 pp. (in Slovak.)
- Baláž E. (2003). Options for preventing the arising of nuisance brown bear individuals. In: *The integrated solution to the problem of nuisance bears (Ursus arctos)*. Rigg R. and Baleková K. eds. Conference proceedings, Nová Sedlica, Slovakia 11-12.4.2002: 7-16.
- Ballard W.B., Carbyn L.N. and Smith D.W. (2003). Wolf interactions with non-prey. In: *Wolves: behavior, ecology and conservation*. Mech D.L. and Boitani L. eds. The University of Chicago Press, Chicago and London: 259-271.
- Bartošová D. (2001). Současný výskyt a ochrana rysa ostrovida, medvěda hnědého a vlka na západním okraji Západních Karpat v CHKO Beskydy. (Present occurrence and protection of the lynx, brown bear and wolf at the western edge of the West Carpathians in Beskydy PLA.) *Chránené územia Slovenska* **47**: 14-17. (in Czech.)
- Bartošová D. (2003). Experiences with the brown bear in Beskydy Protected Landscape Area. In: *The integrated solution to the problem of nuisance bears (Ursus arctos)*. Rigg R. and Baleková K. eds. Conference proceedings, Nová Sedlica, Slovakia 11-12.4.2002: 41-51.
- Baskin L.M. and Vaisfeld M.A. (2005). Dynamics in brown bear populations in European Russia. In: Dalpiaz D. and Genovesi P. (eds.). *16th International Conference on Bear Research and Management – abstracts, program, information*. Provincia Autonoma di Trento a Istituto Nazionale Fauna Selvatica, Trento: 73.
- Bath A. ed. (2005). *Transboundary management of large carnivore populations*. Environmental encounters, No. 60. Council of Europe Publishing, Strasbourg. 130 pp.
- Beecham J. and Watkins V. (2005). An analysis of orphan bear cub rehabilitation efforts, 1970-2005. In: *Abstracts, program, information. 16th International Conference on Bear Research and Management*. Dalpiaz D. and Genovesi P. Provincia Autonoma di Trento and Istituto Nazionale Fauna Selvatica, Trentino: 74.
- Bellemain E., Swenson J.E. and Taberlet P. (2006). Mating strategies in relation to sexually selected infanticide in a non-social carnivore: the brown bear. *Ethology* **112**: 1-9.

- Bevilaqua F. (1985). O medveďoch očami praxe. (On the bear through the eyes of experience.) *Chránené územia Slovenska* **5**: 69-71. (in Slovak.)
- Bevilaqua F. (1995). *Zoči-voči s medveďom*. (Face to face with a bear.) PaRPress, Bratislava. 194 pp.
- Boitani L. (2003). Wolf conservation and recovery. In: *Wolves: behavior, ecology and conservation*. Mech D.L. and Boitani L. eds. The University of Chicago Press, Chicago and London: 317-340.
- Boutin S. (1990). Food supplementation experiments with terrestrial vertebrates: patterns, problems and the future. *Canadian Journal of Zoology* **69**: 203-220.
- Breitenmoser U. (1998). Large predators in the Alps: the fall and rise of man's competitors. *Biological Conservation* **83**(3): 279-289.
- Breitenmoser U., Angst C., Landry J.-M., Breitenmoser-Würsten C., Linnell J.D.C. and Weber J.-M. (2005). Non-lethal techniques for reducing depredation. In: *People and wildlife: conflict or coexistence?* Cambridge University Press, Cambridge: 49-71.
- Burdová L. (2007). Ďalší nárast medvedej populácie nie je žiaduci. (Further growth in the bear population is not desirable.) *Tatry XXXVI*(1): 5. (in Slovak.)
- Chauhan N.P.S. (2002). Activity patterns of sloth bear in fragmented and disturbed areas of Bilaspur Forest Division, Chattishgarh, India. In: *Living with bears. Information, program and abstracts from the 14th International Conference on Bear Research and Management*. Kvam T. and Sørensen O.J. eds. Nord-Trøndelag University College, Steinkjer, Norway: 32.
- Chovancová B. and Kozica T.Z. (2006). Hranice a bariéry. (Borders and barriers.) *Tatry* **1**(4): 24-39. (in Slovak and Polish.)
- Council of Europe (2002). *Convention on the conservation of European wildlife and natural habitats*. Secretariat Memorandum. Directorate of Culture and of Cultural and Natural Heritage, Council of Europe, Strasbourg. 55 pp.
- Crofts R., Zupancic-Vicar M., Marghescu T. and Tederko Z. (2005). IUCN mission to Tatra National Park, Republic of Slovakia, April 2005. Unpublished report. 43 pp.
- Čelechovská O., Literák I., Ondruš S. and Pospíšil Z. (2006). Heavy metals in brown bears from the Central European Carpathians. *Acta Vet. Brno* **75**: 501-506.
- Červený J., Bartošová D., Anděra M. and Koubek P. (2004a). Současné rozšíření medvěda hnědého (*Ursus arctos*) v České republice. (Recent distribution of the brown bear (*Ursus arctos*) in the Czech Republic.) *Lynx* **35**: 19-26. (in Czech with English abstract.)
- Červený J., Hell P., Kamler J., Kholová H., Koubek P., Martínková N. and Slamečka J. (2004b). *Encyklopédia poľovníctva*. (Encyclopaedia of hunting.) Ottovo nakladatelství, Praha. 591 pp. (in Slovak.)
- Červený J., Koubek P., Marhoul P., Nová P., Volf O., Bartošová D., Bufka L. and Bláha J. (2006). Large carnivores: wolf, brown bear and lynx in the Czech Republic. *Environmental Encounters Series* **60**. Council of Europe Publishing, Strasbourg: 45-48.
- Dahle B. and Swenson J.E. (2003a). Factors influencing length of maternal care in brown bears (*Ursus arctos*) and its effect on offspring. *Behav. Ecol. Sociobiol.* **54**: 352-358.
- Dahle B. and Swenson J.E. (2003b). Family breakup in brown bears: are young forced to leave? *Journal of Mammalogy* **84**(2): 536-540.
- Dahle B. and Swenson J.E. (2003c). Home ranges in adult Scandinavian brown bears *Ursus arctos*: effect of population density, mass, sex, reproductive status and habitat type. *Journal of Zoology (London)* **260**: 329-335.
- Dahle B., Zedrosser A. and Swenson J.E. (2006a). Correlates with body size and mass in yearling brown bears (*Ursus arctos*). *Journal of Zoology* **269**: 273-283.

- Dahle B., Støen O.-G. and Swenson J.E. (2006b). Factors influencing home-range size in subadult brown bears. *Journal of Mammalogy* **87**(5): 859-865.
- Danilov P.I. (1994). The brown bear in northwest Russia. *Int. Conf. Bear Res. and Manage.* **9**(1): 199-203.
- Danko Š., Darolová A. and Krištín A. (2002). *Rozšírenie vtákov na Slovensku. (Birds distribution in Slovakia.)* Veda, Bratislava. 686 pp. (in Slovak with English summary.)
- Dečak Đ., Frković A., Grubešić M., Huber Đ., Iviček B., Kulić B., Sertić D. and Štahan Ž. (2005). *Brown bear management plan for the Republic of Croatia.* Ministry of Agriculture, Forestry and Water Management and Ministry of Culture, Zagreb. 90 pp.
- Đurík J. (2000). Plánované veľkoplošné poľovnícke obhospodarovanie veľkých šeliem – základný predpoklad ich prežitia a prosperity. (Planned large-scale hunting management of large carnivores – the basic supposition for their survival and prosperity.) *Hubertlov* **IV**(3): 4-6. (in Slovak.)
- EEA (2006). *Progress towards halting the loss of biodiversity by 2010.* EEA Report No. 5. European Environment Agency, Copenhagen. 100 pp.
- Farkáš J., Lehocký M., Cibula R., Jurkecková H., Šniderová R. and Hošková A. (2001a). *Poľovnícka štatistika ročenka slovenskej republiky za rok 2000. (Hunting statistics yearbook of the Slovak Republic for the year 2000.)* Lesnícký výskumný ústav, Zvolen. (in Slovak.)
- Farkáš J., Lehocký M., Cibula R., Jurkecková H. and Murgašová A. (2001b). *Poľovnícka štatistika ročenka slovenskej republiky za rok 2001. (Hunting statistics yearbook of the Slovak Republic for the year 2001.)* Lesnícký výskumný ústav, Zvolen. (in Slovak.)
- Feriancová Z. (1955). Rozšírenie niektorých vzácnych druhov cicavcov na Slovensku. (The distribution of some rare mammal species in Slovakia.) *Práce 2. sekcie Slovenska akademia vied* **1**: 30-40. (in Slovak.)
- Frackowiak W., Gula R. and Perzanowski K. (1999). Status and management of the brown bear in Poland. In: *Bears. Status survey and conservation action plan.* Servheen C., Herrero S. and Peyton B. compilers. IUCN Gland, Switzerland and Cambridge, UK: 89-93.
- Frackowiak W. and Perzanowski K. (2002). *The past, present and future of brown bear population in Poland.* URL: <http://www.uma.edu/art/Wolf/ResearchA1.html>
- Friebe A., Swenson J.E. and Sandegren F. (2001). Denning chronology of female brown bears in central Sweden. *Ursus* **12**: 37-46.
- Frković A., Huber D. and Kusak J. (2001). Brown bear litter sizes in Croatia. *Ursus* **12**: 103-106.
- Gočál E. (1989). Človek versus medveď. (Man versus bear.) *Chránené územia Slovenska* **12**: 68-71. (in Slovak.)
- Goldová M., Ciberej J. and Rigg R. (2003). Medveď hnedý (*Ursus arctos*) a parazitárne zoonózy. (The brown bear (*Ursus arctos*) and parasitic zoonoses.) *Folia Venatoria* **33**: 123-127. (in Slovak with English summary.)
- Hájek B. (1987). Medvede usmrtené železničnou dopravou. (Bears killed by rail transport.) *Chránené územia Slovenska* **9**: 19. (in Slovak.)
- Hála J. (1942). *Pod Tatrami. (Beneath the Tatras.)* Transcius, Liptovský Mikuláš. 186 pp. (in Slovak with English summary.)
- Halák K. (1993). Populácia medveďa hnedého (*Ursus arctos* L., 1758) v Západných Tatrách. (The population of the brown bear (*Ursus arctos* L., 1758) in the Western Tatras.) *Zborník prác o Tatranskom Národnom Parku* **33**: 227-234. (in Slovak with English summary.)
- Hapl E. and Uhrin M. (2000). Čo s opustenými mláďatami medveďa hnedého, alebo štyri prípady a viacero otázok 2. Čo s medveďaťom? (What to do with abandoned brown

- bear cubs, or four cases and more questions 2. What to do with the bear cub?) *Chránené územia Slovenska* **46**: 26-27. (in Slovak.)
- Hartl G.B. and Hell P. (1994). Maintenance of high levels of allelic variation in spite of a severe bottleneck in population size: the brown bear (*Ursus arctos*) in the Western Carpathians. *Biodiversity and Conservation* **3**: 546-554.
- Hell P. (2003). Current problems of the co-existence of man and bear in the Slovak Carpathians and options for their solution. In: *The integrated solution to the problem of nuisance bears (Ursus arctos)*. Rigg R. and Baleková K. eds. Conference proceedings, Nová Sedlica, Slovakia 11-12.4.2002: 65-75.
- Hell P. (2005). Poľovníctvo v krajinách EU. (Hunting in countries of the EU.) *Naše poľovníctvo II(2)*: 10-11. (in Slovak.)
- Hell P. and Bevilaqua F. (1988). Das Zusammenleben des Menschen mit dem Braunbären (*Ursus arctos*) in den Westkarpaten. (The coexistence of humans and brown bears (*Ursus arctos*) in the West Carpathians.) *Zeitschr. Jagdwiss.* **34(3)**: 153-163. (in German.)
- Hell P. and Find'o S. (1999). Status and management of the brown bear in Slovakia. In: *Bears. Status survey and conservation action plan*. Servheen C., Herrero S. and Peyton B. compilers. IUCN Gland, Switzerland and Cambridge, UK: 96-100.
- Hell P. and Sabadoš K. (1993). Zhodnotenie úlovku medved'ov hnedých v západných Karpatoch v rokoch 1980-1991. (Evaluation of the bag of brown bear in the Western Carpathians during 1980 to 1991.) *Folia Venatoria* **23**: 183-200. (in Slovak with English summary.)
- Hell P. and Sabadoš K. (1995). Niektoré parametre západokarpatskej populácie medveďa hnedého (*Ursus arctos*) v roku 1992. (Some parameters of the Western-Carpathians population of brown bear (*Ursus arctos*) in 1992.) *Folia Venatoria* **25**: 97-104. (in Slovak with English summary.)
- Hell P. and Sládek J. (1994). Telesné miery medveďa hnedého v západných Karpatoch. (Body measures of the brown bear in the West-Carpathians.) *Folia Venatoria* **24**: 111-122. (in Slovak.)
- Hell P. and Slamečka J. (1999). *Medveď v slovenských Karpatoch a vo svete. (The bear in the Slovak Carpathians and in the world.)* PaRPress, Bratislava. 150 pp. (in Slovak.)
- Hell P., Konôpka J., Lehocký M., Farkaš J. and Sabadoš K. (2001). *Slovenské poľovníctvo na prahu tretieho tisícročia. (Slovak wildlife management on the threshold of the third millenium.)* PaRPress, Bratislava. 177 pp. (in Slovak.)
- Hell P., Bučko J., Slamečka J., Šebo M. and Garaj P. (2005). Ochrana a obhospodarovanie veľkých šeliem na Slovensku. (Conservation and management of large carnivores in Slovakia.) In: *Zborník referátov z medzinárodnej konferencie Levice, 12.03.2005. Výskumný ústav živočíšnej výroby, Nitra: 7-19.* (in Slovak.)
- Herrero S. (1985). *Bear attacks: their causes and avoidance*. 1st ed. The Lyons Press, N.Y. 287 pp.
- Hlásnik J. (2002). Problematika riešenia škôd, spôsobených chránenými druhmi zveri. (The issue of solving damage caused by protected game species.) Material presented at the 19.3.2002 meeting of the Commission for Large Carnivores. 3 pp. (in Slovak.)
- Hlaváč O. (1995). Človek medveďovi sudca, vinník i kat. (Man the bear's judge, culprit and executioner.) *Tatry XXXIV(2)*: 2-3. (in Slovak.)
- Huber D. and Roth H.U. (1993). Movements of European brown bears in Croatia. *Acta Theriologica* **38(2)**: 151-159.
- Huber D., Kusak J. and Frkovic A. (1998). Traffic kills of brown bears in Gorski Kotar, Croatia. *Ursus* **10**: 167-171.

- Jakubiec Z. (2001). *Niedźwiedź brunatny Ursus arctos L. w Polskiej części Karpat. (The brown bear Ursus arctos L. in the Polish part of the Carpathians.)* Polska Akademia Nauk, Kraków. 108 pp. (in Polish with English summary.)
- Jakubiec Z. (2003). Conservation activities affecting the bear population in Poland. In: *The integrated solution to the problem of nuisance bears (Ursus arctos)*. Rigg R. and Baleková K. eds. Conference proceedings, Nová Sedlica, Slovakia 11-12.4.2002: 95-104.
- Jakubiec Z., Delimat A., Konieczny K., Wuczyński A. and Zięba F. (2003). Żerowanie niedźwiedzi na ziołoroślach nad Morskim Okiem. (Feeding of bears in the tall herb communities in the Morskie Oko Valley.) *Chrońmy przyrodę ojczystą* **59(2)**: 58-77. (in Polish with English summary.)
- Jamnický J. (1976). Spôsoby a príčiny poškodzovania stromov medveďom hnedým (*Ursus arctos* L.). (Methods and reasons for damage to trees by the brown bear (*Ursus arctos* L.).) *Folia Venatoria* **5-6**: 120-135. (in Slovak.)
- Jamnický J. (1987). Formy komunikácie medveďa hnedého (*Ursus arctos* L.). (Forms of communication of the brown bear (*Ursus arctos* L.).) *Folia Venatoria* **17**: 151-167. (in Slovak with English summary.)
- Jamnický J. (1988a). Význam starých samcov v populácii medveďa. (The significance of old males in the bear population.) *Poľovníctvo a rybárstvo* **40**: 413. (in Slovak.)
- Jamnický J. (1988b). Potrava medveďa hnedého (*Ursus arctos* L.) v tatranskej oblasti. (The diet of the brown bear (*Ursus arctos* L.) in the Tatra region.) *Folia Venatoria* **18**: 197-213. (in Slovak with English summary.)
- Jamnický J. (1993). Lov medveďa hnedého a vlka obyčajného na Slovensku pred sto rokmi. (The hunt of the brown bear and European wolf in Slovakia a hundred years ago.) *Folia Venatoria* **23**: 221-229. (in Slovak with English summary.)
- Janík M. (1982). Príspevok k poznaniu ekológie medveďa hnedého (*Ursus arctos*) a ochrana jeho populácie v Západných Karpatoch. (Contribution to knowledge of brown bear (*Ursus arctos*) ecology and the conservation of its population in the West Carpathians.) *Ochrana prírody* **4**: 139-190. (in Slovak.)
- Janík M. (1987). Effect of one-sided selection on brown bear population in Slovakia. In: *Problematika medveďa na Slovensku*. Štollam A. (ed.). Zborník referátov z odborného seminára. VÚLH, Zvolen: 64-72.
- Janík M. (1997). Biogeography, demography and management of *Ursus arctos* in the Western Carpathians. *Int. Conf. Bear Res. and Manage.* **9(2)**: 125-128.
- Janík M., Voskár J. and Buday M. (1986). Present distribution of the brown bear (*Ursus arctos*) in Czechoslovakia. *Folia Venatoria* **16**: 331-352.
- Jasík M., Danko M., Ondruš S. and Turis P. (2003). Prírodné hodnoty Nízkyh Tatier po 25 rokoch územnej ochrany. (Natural values of Nízke Tatry after 25 years of area conservation.) *Ochrana prírody Slovenska* **2003(4)**: 6-7. (in Slovak.)
- Jerguš Š. (1972). Štyridsať rokov ochrany medveďa na Slovensku. (Forty years of bear protection in Slovakia.) *Poľovníctvo a rybárstvo* **8**: 6. (in Slovak.)
- Jerina K. and Adamic M. (2002). The brown bear's (*Ursus arctos*) spatial expansion in Slovenia: speed of expansion and saturation dependent dispersion. In: *Living with bears. Information, program and abstracts from the 14th International Conference on Bear Research and Management*. Kvam T. and Sørensen O.J. eds. Nord-Trøndelag University College, Steinkjer, Norway: 79.
- Jerina K., Adamič M., Marenče M. and Jonožovič M. (2005). Transportation-related mortality of brown bears in Slovenia. In: Dalpiaz D. and Genovesi P. (eds.). *16th International Conference on Bear Research and Management – abstracts, program, information*. Provincia Autonoma di Trento a Istituto Nazionale Fauna Selvatica, Trento: 104.

- Jób M. (2007). *Uplatnenie environmentálneho manažérstva v ochrane ohrozených druhov fauny – návrh manažmentu ochrany medveďa hnedého na príklade územia obce Staré Hory. (The application of environmental management in the conservation of endangered species of fauna – a proposal for the conservation management of the brown bear using Staré Hory community as an example.)* Masters thesis. Univerzita Mateja Bela v Banskej Bystrici. 101 pp. (in Slovak.)
- Jonozovic M. and Adamic M. (2002). Density of European brown bears and the extent of reported bear damages in Slovenia: do they have anything in common? In: *Living with bears. Information, program and abstracts from the 14th International Conference on Bear Research and Management*. Kvam T. and Sørensen O.J. eds. Nord-Trøndelag University College, Steinkjer, Norway: 82.
- Kacerová V. (2005). Medveďa zabil igelit. (Plastic killed a bear.) *Chránené územia Slovenska* **63**: 25. (in Slovak.)
- Kadlečík J. (1983). Niektoré problémy poľovníctva a ochrany fauny v CHKO Veľká Fatra. (Some problems of hunting and protection of the fauna in Veľká Fatra PLA.) *Spravodajca chránených území Slovenska* **2**: 80-83. (in Slovak.)
- Karč P. (1977). Rozšírenie vlka a medveďa v Liptove koncom 18. a v prvej polovici 19. storočia. (The distribution of the wolf and bear in Liptov at the end of the 18th and in the first half of the 19th centuries.) *Vlastivedný zborník Liptov* **4**: 59-95. (in Slovak.)
- Karč P. (2007). Poľovná zver Liptova v historickej retrospective. (Game animals of Liptov in a historical retrospective.) In: *Poľovníctvo v Liptove. (Hunting in Liptov.)* Churý S., Jančovič D., Jaroš F., Karč P., Košecký I., Mráz I., Oško J., Radúch J., Šagát D., Šramka Š., Vítek P. and Vrlík P. Okresná organizácia SPZ, Liptovský Mikuláš and Okresná organizácia SPZ, Ružomberok: 95-170.
- Kassa M. (1995). Vyhodnotenie lovu medveďa hnedého v roku 1994 na Slovensku. (Evaluation of the hunting of the brown bear in 1994 in Slovakia.) *Chránené územia Slovenska* **23**: 25-26. (in Slovak.)
- Kassa M. (1996). Vyhodnotenie lovu medveďa hnedého v roku 1995 na Slovensku. (Evaluation of the hunting of the brown bear in 1995 in Slovakia.) *Chránené územia Slovenska* **27**: 31-33. (in Slovak with English summary.)
- Kassa M. (1997). Vyhodnotenie lovu medveďa hnedého na Slovensku v roku 1996. (Evaluation of the hunting of the brown bear in Slovakia in 1996.) *Chránené územia Slovenska* **31**: 33-34. (in Slovak.)
- Kassa M. (1998a). Určovanie hmotnosti medveďa hnedého (*Ursus arctos*) na základe veľkosti jeho stôp. (Determining the weight of the brown bear (*Ursus arctos*) on the basis of its tracks.) *Chránené územia Slovenska* **38**: 19-20. (in Slovak.)
- Kassa M. (1998b). Analýza lovu medveďa hnedého (*Ursus arctos*) na Slovensku. (Analysis of brown bear (*Ursus arctos*) hunting in Slovakia.) *Chránené územia Slovenska* **38**: 20-22. (in Slovak.)
- Kassa M. (1999a). Škody spôsobené medveďom v roku 1998 na Slovensku. (Damage caused by the bear in 1998 in Slovakia.) *Chránené územia Slovenska* **40**: 23-24. (in Slovak.)
- Kassa M. (1999b). Vyhodnotenie regulácie početnosti medveďa hnedého na Slovensku v roku 1998. (Evaluation of the regulation of brown bear numbers in Slovakia in 1998.) *Chránené územia Slovenska* **40**: 25-27. (in Slovak.)
- Kassa M. (2000a). Vyhodnotenie regulácie početnosti medveďa hnedého na Slovensku v roku 1999. (Evaluation of the regulation of brown bear numbers in Slovakia in 1999.) *Chránené územia Slovenska* **44**: 19-22. (in Slovak.)
- Kassa M. (2000b). Jednotné criteria pre povoľovanie výnimiek z ochrany medveďa hnedého v rámci regulačného lovu na Slovensku v roku 2000. (Unified criteria for permitting

- exceptions from the protection of the brown bear within the framework of regulation hunting in Slovakia in 2000.) *Chránené územia Slovenska* **44**: 9. (in Slovak.)
- Kassa M. (2001a). Vyhodnotenie regulácie početnosti medveďa hnedého na Slovensku v roku 2000. (Evaluation of the regulation of brown bear numbers in Slovakia in 2000.) *Chránené územia Slovenska* **47**: 19-22. (in Slovak.)
- Kassa M. (2001b). Škody spôsobené medveďom hnedým v roku 2000. (Damage caused by the brown bear in 2000.) *Chránené územia Slovenska* **47**: 22-23. (in Slovak.)
- Kassa M. (2002a). Vyhodnotenie regulácie početnosti medveďa hnedého v roku 2001 na Slovensku. (Evaluation of the regulation of brown bear numbers in 2001 in Slovakia.) *Chránené územia Slovenska* **51**: 11-15. (in Slovak.)
- Kassa M. (2002b). Škody spôsobené medveďom v roku 2001. (Damage caused by the bear in 2001.) *Chránené územia Slovenska* **51**: 16. (in Slovak.)
- Kassa M. (2003). Management system of the brown bear in Slovakia. In: *The integrated solution to the problem of nuisance bears (Ursus arctos)*. Rigg R. and Baleková K. eds. Conference proceedings, Nová Sedlica, Slovakia 11-12.4.2002: 17-25.
- Kassa M. (2005). Slovakia and the transboundary management of large carnivores populations within of Carpathians. In: *Transboundary management of large carnivore populations*. Bath A. ed. Environmental encounters, No. 60. Council of Europe Publishing, Strasbourg: 84-90.
- Kassa M. (2006). Vyhodnotenie regulácie početnosti populácie medveďa hnedého v rokoch 2002-2004 na Slovensku. (Evaluation of the regulation of brown bear population numbers in 2002-2004 in Slovakia.) *Chránené územia Slovenska* **68**: 10-23. (in Slovak.)
- Kaštier P. (2004). *Summary by district of results from national hunters' questionnaire Poľov 1-01 for the years 2000, 2001 and 2002*. Commissioned report. Zvolen Forestry Research Institute, Zvolen. (in Slovak.)
- Kemp G.A. (1974). *The dynamics and regulation of black bear (Ursus americanus) populations in northern Alberta*. Alberta Fish and Wildlife Division. Unpubl. report. 15 pp.
- Kendall K.C., Stetz J.B., Roon D.A. and Waits L.P. (2005). Sampling bears using rub trees. In: *Abstracts, program, information. 16th International Conference on Bear Research and Management*. Dalpiaz D. and Genovesi P. Provincia Autonoma di Trento and Istituto Nazionale Fauna Selvatica, Trentino: 110.
- Klescht V. and Valachovič D. (2002). *Ochrana živočíchov na pozemných komunikáciách. (Protection of animals on terrestrial thoroughfares.)* State Nature Conservancy of the Slovak Republic, Banská Bystrica. 95 pp.
- Knapp A. (2006). *Bear necessities. An analysis of brown bear management and trade in selected range states and the European Union's role in the trophy trade*. TRAFFIC Europe, Brussels. 76 pp.
- Kohn M., Knauer F., Stoffella A., Schröder W. and Pääbo S. (1995). Conservation genetics of the European brown bear – a study using excremental PCR of nuclear and mitochondrial sequences. *Molecular Ecology* **4**: 95-103.
- Kopečna M., Ondrus S., Literak I., Klimes J., Horvathova A., Moravkova M., Bartos M., Trcka I. and Pavlik I. (2006). Detection of *Mycobacterium avium* subsp. *paratuberculosis* in two brown bears in the Central European Carpathians. *J. Wild. Diseases* **42(3)**: 691–695.
- Košecký I., Oško J. and Radúch J. (2007). Hlavné druhy poľovnej zveri a ich obhospodarovanie. (The main species of game animals and their management.) In: *Poľovníctvo v Liptove. (Hunting in Liptov.)* Churý S., Jančovič D., Jaroš F., Karč P., Košecký I., Mráz I., Oško J., Radúch J., Šagát D., Šramka Š., Vítek P. and Vrlík P. Okresná organizácia SPZ, Liptovský Mikuláš and Okresná organizácia SPZ, Ružomberok: 171-227.

- Kovács P. (2006). Na vine je nevedomosť? (Ignorance is to blame?) *Naše poľovníctvo* **III(5)**: 9. (in Slovak.)
- Kováč J. (1987). Zvedavou kamerou. (With a curious camera.) *Vysoké Tatry* **XXVI(5)**: 29.
- Kováč J. (2003). The issue of nuisance bears in the Tatras National Park. In: *The integrated solution to the problem of nuisance bears (Ursus arctos)*. Rigg R. and Baleková K. eds. Conference proceedings, Nová Sedlica, Slovakia 11-12.4.2002: 77-88.
- Kováčiková M. (2003). Podbanské sa mu stalo domovom. (Podbanské became his home.) *Tatry* **XLII(4)**: 8-9. (in Slovak.)
- Kráľ P. (2001). Prikrmovanie medvedíkov. (Feeding bears.) *Tatry* **XL(2)**: 6. (in Slovak.)
- Kramárik J. (1995). Vyhodnotenie plnenia "Projektu budovania siete chránených území v SSR do r.2000". (Evaluation of completing the "Project of building a network of protected areas in SSR up to 2000".) *Chránené územia Slovenska* **23**: 2-3. (in Slovak.)
- Krchniak M. (2001). Na prechodnom pobyte. (On a temporary stay.) *Chránené územia Slovenska*. **47**: 18-19. (in Slovak.)
- Kryštufek B., Flajšman B. and Griffiths H.I. eds. (2003). *Living with bears: a large carnivore in a shrinking world*. Ecological Forum LDS, Ljubljana. 368 pp.
- Kunc L. (1996). *Z medvedích a vlčích brlohů*. (From the dens of bears and wolves.) Český svaz ochránců přírody, Valašské Meziříčí. 134 pp. (in Czech.)
- LCIE (2002). *Large Carnivore Initiative for Europe Core Group position statement on the use of hunting, and lethal control, as means of managing large carnivore populations*. Council of Europe, Strasbourg. 4 pp.
- Lehocký M. (2002). Veľkoplošné sčítanie šeliem. (Large-area census of carnivores.) *Poľovníctvo a rybárstvo* **54(6)**: 8-9. (in Slovak.)
- Lehocký M., Kaštier P., Cibula R., Jurkecková H. and Murgašová A. (2003a). *Poľovnícka štatistika ročenka slovenskej republiky za rok 2002*. (Hunting statistics yearbook of the Slovak Republic for the year 2002.) Lesnícký výskumný ústav, Zvolen. (in Slovak.)
- Lehocký M., Cibula R. and Kaštier P. (2003b). Výsledky poľovníckej štatistiky na Slovensku za rok 2002. (Results of hunting statistics in Slovakia for the year 2002.) *Poľovníctvo a rybárstvo* **55(10)**: 20-21. (in Slovak.)
- Lenko P. (2005). Spočítanie veľkých šeliem, svišťa a kurovitých vtákov v Tatranskom národnom parku. (Census of large carnivores, marmots and grouse in Tatranský National Park.) *Chránené územia Slovenska* **65**: 23-24. (in Slovak.)
- Lenko P. (2006). Veľké šelmy v Západných Tatrách. (Large carnivores in Západné Tatry.) *Naše poľovníctvo* **III(1)**: 16-17. (in Slovak.)
- Levin M. (2002). How to prevent damage from large predators with electric fences. *Carnivore Damage Prevention News* **5**: 5-8.
- Lihocký P. (2006). Medveď hnedý v slovenských Karpatoch. (The brown bear in the Slovak Carpathians.) *Hubertov* **X(5)**: 24-25.
- Linnell J.D.C., Smith M.E., Odden J., Kaczensky P. and Swenson J. (1996). *Carnivores and sheep farming in Norway. 4. Strategies for the reduction of carnivore-livestock conflicts: a review*. Norwegian Institute for Nature Research Oppdragsmelding 443. 118 pp.
- Linnell J.D.C., Aanes R., Swenson J.E., Odden J., and Smith M.E. (1997). Translocation of carnivores as a method for managing problem animals: a review. *Biodiversity and Conservation* **6**: 1245-1257.
- Linnell J.D.C., Swenson J.E., Landa A. and Kvam T. (1998). *Methods for monitoring European large carnivores – a worldwide review of relevant experience*. Norwegian Institute for Nature Research Oppdragsmelding 549. 38 pp.
- Linnell J.D.C., Swenson J.E., Andersen R. and Barnes B. (2000). How vulnerable are denning bears to disturbance? *Wildlife Society Bulletin* **28**: 400-413.

- Linnell J.D.C., Andersen R., Andersone Ž., Balčiauskas L., Blanco J.C., Boitani L., Brainerd S., Breitenmoser U., Kojola I., Liberg O., Løe J., Okarma H., Pedersen H.C., Promberger C., Sand H., Solberg E.J., Valdmann H. and Wabakken P. (2002a). *The fear of wolves: A review of wolf attacks on humans*. Norwegian Institute for Nature Research Oppdragsmelding 731. 65 pp.
- Linnell J.D.C., Steuer D., Odden J., Kaczensky P. and Swenson J.E. (2002b). *European brown bear compendium*. Wildlife Conservation Issues – Technical Series No. 004A. Safari Club International Foundation, Herndon VA. 131 pp.
- Linnell J.D.C., Nilsen E.B., Lande U.S., Herfindal I., Odden J., Skogen K., Andersen R. and Breitenmoser U. (2005). Zoning as a means of mitigating conflicts with large carnivores: principles and reality. In: *People and wildlife: conflict or coexistence?* Woodroffe R., Thirgood S. and Rabinowitz A. eds. Cambridge University Press, Cambridge: 162-175.
- Litvaitis J.A., Titus K. and Anderson E. (1996). Measuring vertebrate use of terrestrial habitats and foods. In: *Research and management techniques for wildlife and habitats*. 5th ed., rev. Bookhout T.A. ed. The Wildlife Society, Bethesda, Md.: 254-274.
- MacHutchon A.G. (2001). Grizzly bear activity budget and pattern in the Firth River Valley, Yukon. *Ursus* **12**: 189-198.
- Maanen E. van, Predoiu G., Klaver R., Soulé M., Popa M., Ionescu O., Jurj R., Negus S., Ionescu G. and Altenburg W. (2006). *Safeguarding the Romanian Carpathian ecological network. A vision for large carnivores and biodiversity in Eastern Europe*. A&W ecological consultants, Veenwouden and ICAS Wildlife Unit, Braşov. 158 pp.
- Macdonald D.W. and Barrett P. (1993). *Mammals of Britain and Europe*. Collins, London. 448 pp.
- Manchi S. and Swenson J.E. (2005). Denning behaviour of Scandinavian brown bears *Ursus arctos*. *Wildl. Biol.* **11**: 123-132.
- Martínková N. and Zahradníková A. (2003). The brown bear in Slovakia. In: *Living with bears: a large carnivore in a shrinking world*. Kryštufek B., Flajšman B. and Griffiths H.I. eds. Ecological Forum LDS, Ljubljana: 258-271.
- McLellan B.N. (2005). Sexually selected infanticide in grizzly bears: the effects of hunting on cub survival. *Ursus* **16(2)**: 141-156.
- Meadows L.E., Andelt W.F. and Beck T.D.I. (2006). *Managing bear damage to beehives*. Colorado State University. URL: <http://www.ext.colostate.edu/pubs/natres/06519.html>.
- Mertens A. and Sandor A. (2000). Bears. In: *Carpathian Large Carnivore Project annual report 2000*. CLCP. S&G Print, Haco International: 14-15.
- Mertens A., Promberger C. and Gheorge P. (2002). Testing and implementing the use of electric fences for night corrals in Romania. *Carnivore Damage Prevention News* **5**: 2-5.
- Metera D., Pezold T. and Piwowarski W. (2005). *Implementation of Natura 2000 in new EU Member States of Central Europe: assessment report*. IUCN, Warsaw. 55 pp.
- Mihál I. (1985). *Tatranskou prírodou. (Tatran nature.)* Príroda, Bratislava. 223 pp.
- Miller S.D., Sellers R.A. and Keay J.A. (2003). Effects of hunting on brown bear cub survival and litter size in Alaska. *Ursus* **14(2)**: 130-152.
- Mind'áš J., Konôpka J., Novotný J. and Jendek S. (2006). Lesy Slovenska. (Forests of Slovakia.) Národné lesnícke centrum, Zvolen. 222 pp. (in Slovak.)
- Mituch J. (1972). Helmintofauna mäsožravcov na Slovensku a v ČSSR. (Helminths of carnivores in Slovakia and Czechoslovakia.) *Folia Venatoria* **10-11**: 15-33. (in Slovak.)
- MP SR (2002). *Green Report 2002*. Ministry of Agriculture of the Slovak Republic, Bratislava.
- MP SR (2005). *Green Report 2005*. Ministry of Agriculture of the Slovak Republic, Bratislava.

- Mueller C., Herrero S. and Gibeau M.L. (2004). Distribution of subadult grizzly bears in relation to human development in the Bow River Watershed, Alberta. *Int. Conf. Bear Res. and Manage.* **15(1)**: 35-47.
- Nyhus P.J., Osofsky S.A., Ferraro P., Madden F. and Fischer H. (2005). Bearing the costs of human-wildlife conflict: the challenges of compensation schemes. In: *People and wildlife: conflict or coexistence?* Cambridge University Press, Cambridge: 107-121.
- Okarma H., Dovhanych Y., Find'o S., Ionescu O., Koubek P. and Szemethy L. (2000). *Status of carnivores in the Carpathian ecoregion*. Carpathian Ecoregion Initiative. 37 pp.
- Ondruš S. (2000). Pokus o znovunavrátanie odchyteneho mláďaťa medveďa hnedého (*Ursus arctos*) do voľnej prírody. (An attempt to re-release a captured brown bear (*Ursus arctos*) cub to the wild. *Chránené územia Slovenska* **45**: 16-17. (in Slovak.)
- Ondruš S. (2005). Medveď hnedý (*Ursus arctos*) – vyhodnotenie regulačného lovu v roku 2005 v územnej pôsobnosti Správy Národného parku Nízke Tatry. (The brown bear (*Ursus arctos*) – evaluation of regulation hunting in 2005 in the area of jurisdiction of Nízke Tatry National Park administration.) In: *Ročenka 2005. (Yearbook 2005.)* Správa Národného parku Nízke Tatry, Liptovský Hrádok: 28-29. (in Slovak.)
- Palomero G., Fernandez A. and Naves J. (1997). Reproductive rates of brown bears in the Cantabrian Mountains, Spain. *Int. Conf. Bear Res. and Manage.* **9(2)**: 129-132.
- Paule L., Krajmerová D., Urban P. and Adamec M. (2006). Príspevok k poznaniu genetickej diversity medveďa hnedého (*Ursus arctos* L.) zo Západných Karpát. (Contribution to genetic diversity of brown bear (*Ursus arctos* L.) from the Western Carpathians. *Výskum a ochrana cicavcov na Slovensku VII*: 115-121. (in Slovak with English abstract.)
- Paunović M. and Čirović D. (2006). *Viability increase and recovery of Brown Bear Ursus arctos L. 1758 population in northeastern Serbia – a feasibility study*. Faculty of Biology, University of Belgrade, Belgrade. 52 pp.
- Pažetnov V.S. (1985). *Moji družja medvedi. (My friendship with bears.)* Agropromizdat, Moscow. 125 pp. (in Russian.)
- Pazetnov V. and Pazetnov S. (2005). Female brown bear with six cubs. *International Bear News* **14(2)**: 17.
- Pazhetnov S.V. (2005). Release of brown bear cubs born in zoo into nature. In: Dalpiaz D. and Genovesi P. (eds.). *16th International Conference on Bear Research and Management – abstracts, program, information*. Provincia Autonoma di Trento a Istituto Nazionale Fauna Selvatica, Trento: 128.
- Pčola Š. (2003). Current status of the bear population in the Slovak Eastern Carpathians. In: *The integrated solution to the problem of nuisance bears (Ursus arctos)*. Rigg R. and Baleková K. eds. Conference proceedings, Nová Sedlica, Slovakia 11-12.4.2002: 127-130.
- Pelikán V. (1983). Zaujímavosti z CHKO Muránska planina. (Interesting observations from Muránska planina PLA.) *Spravodajca chránených území Slovenska* **2**: 94. (in Slovak.)
- Peralvo M. and Cuesta F. (2002). Priority areas for Andean bear habitat conservation in the ecological reserve Cayambe-Coca and its influence zone, Ecuador. In: *Living with bears. Information, program and abstracts from the 14th International Conference on Bear Research and Management*. Kvam T. and Sørensen O.J. eds. Nord-Trøndelag University College, Steinkjer, Norway: 63.
- Pilinský P. (2001a). *Záznam z pracovného rokovania medzirezortnej Komisie pre veľké šelmy. (Minutes of a working meeting of the inter-departmental Commission for Large Carnivores.)* 5 pp. (in Slovak.)
- Pilinský P. (2001b). Prvé zasadnutie Komisie pre veľké šelmy. (First meeting of the Commission for Large Carnivores.) *Chránené územia Slovenska* **47**: 24. (in Slovak.)

- Podlesný Ľ. (2006). Stalo sa na ceste. (It happened on the road.) *Naše poľovníctvo* **III(1)**: 9. (in Slovak.)
- Podruzny S.R., Cherry S., Schwartz C.C. and Landenburger L.A. (2002). Grizzly bear denning and potential conflict areas in the Greater Yellowstone Ecosystem. *Ursus* **13**: 19-28.
- Polák P. and Saxa A. (2005). *Priaznivý stav biotopov a druhov európskeho významu. Manuál k programom starostlivosti o územia NATURA 2000. (Favourable status of habitats and species of European importance. Manual for a programme of care of Natura 2000 sites.)* State Nature Conservancy of the Slovak Republic, Banská Bystrica. 734 pp. (in Slovak.)
- Quigley H. and Herrero S. (2005). Characterisation and prevention of attacks on humans. In: *People and wildlife: conflict or coexistence?* Woodroffe R., Thirgood S. and Rabinowitz A. eds. Cambridge University Press, Cambridge: 27-48.
- Randi E., Gentile L., Boscagli G., Huber D. and Roth H.U. (1994). Mitochondrial DNA sequence divergence among some west European brown bear (*Ursus arctos*) populations: lessons for conservation. *Heredity* **73**: 480-489.
- Randík A. (1971). Rozšírenie a ochrana medveďa hnedého v Československu. (Distribution and protection of the brown bear in Czechoslovakia.) *Čsl. ochrana prírody* **11**. (in Slovak.)
- Rauer G. (2003). Brown bear management in Austria: experiences with aversive conditioning. In: *The integrated solution to the problem of nuisance bears (Ursus arctos)*. Rigg R. and Baleková K. eds. Conference proceedings, Nová Sedlica, Slovakia 11-12.4.2002: 119-126.
- Rauer G., Kaczensky P. and Knauer F. (2003). Experiences with aversive conditioning of habituated brown bears in Austria and other European countries. *Ursus* **14(2)**: 215-224.
- Rigg R. (2001). *Livestock guarding dogs: their current use world wide*. IUCN/SSC Canid Specialist Group Occasional Paper No 1 [online]. 133 pp. URL: <http://www.canids.org/occasionalpapers>
- Rigg R. (2002). *The use of livestock guarding dogs to protect sheep and goats from large carnivores in Slovakia*. Unpublished report. The Slovak Wildlife Society. 39 pp.
- Rigg R. (2003). The use of livestock guarding dogs to protect sheep and goats from bears and wolves. In: *The integrated solution to the problem of nuisance bears (Ursus arctos)*. Rigg R. and Baleková K. eds. Sloboda zvierat, Bratislava: 27-40.
- Rigg R. (2004a). *The extent of predation on livestock by large carnivores in Slovakia and mitigating carnivore-human conflict using livestock guarding dogs*. Masters thesis. University of Aberdeen, Aberdeen. 263 pp.
- Rigg R. (2004b). Slovakia and Poland: different countries, different attitudes. *International Bear News* **13(4)**: 21-22.
- Rigg R. (2005a). Livestock depredation and livestock guarding dogs in Slovakia. *Carnivore Damage Prevention News* **8**: 17-27.
- Rigg R. (2005b). Status of brown bears in the Ukraine. *International Bear News* **14(2)**: 20.
- Rigg R. and Baleková K. eds. (2003). *The integrated solution to the problem of nuisance bears (Ursus arctos)*. Sloboda zvierat, Bratislava. 142 pp.
- Rigg R. and Gorman M. (2006a). Potrava medveďa hnedého (*Ursus arctos*): nové výsledky z Tatranskej oblasti a porovnanie metód výskumu. (Diet of brown bears (*Ursus arctos*): new results from the Tatras region and a comparison of research methods.) *Výskum a ochrana cicavcov na Slovensku* **VII**: 61-79. (in Slovak with English abstract.)
- Rigg R. and Gorman M. (2006b). Predácia veľkých šeliem na ovce na Slovensku. (Predation on sheep by large carnivores in Slovakia.) *Výskum a ochrana cicavcov na Slovensku* **VII**: 81-89. (in Slovak with English abstract.)

- Rigg R., Gorman M. and Sillero-Zubiri C. (2003). Livestock guarding dogs and their modern role in large carnivore conservation initiatives. In: *World Wolf Congress 2003 Bridging science and community. Book of abstracts*. Banff, Canada: 41.
- Rogner R. (2003). Bears in the Czech Republic in the wild and in captivity. In: *The integrated solution to the problem of nuisance bears (Ursus arctos)*. Rigg R. and Baleková K. eds. Sloboda zvierat, Bratislava: 109-118.
- Saarma U., Ho S.Y.W., Pybus O.G., Kaljuste M., Tumanov I.L., Kojola I., Vorobiev A., Markov N.I., Saveljev A.P., Valdmann H., Lyapunova E.A., Abramov A.V., Männil P., Korsten M., Vulla E., Pazetnov S.V., Pazetnov V.S., Putchkovskiy S.V. and Rõkov A.M. (2007). Mitogenetic structure of brown bears (*Ursus arctos* L.) in northeastern Europe and a new time frame for the formation of European brown bear lineages. *Molecular Ecology* **16**: 401-413.
- Sabadoš K. and Šimiak M. (1981). Rozšírenie a poľovné obhospodarovanie medveďa hnedého (*Ursus arctos*) na Slovensku. (Distribution and management of the brown bear (*Ursus arctos*) in Slovakia.) *Folia Venatoria* **10-11**: 15-33. (in Slovak with English summary.)
- Salvatori V. (2003). Mapping environmental suitability for large carnivores in the Carpathians. In: *Carpathian workshop on large carnivore conservation*. Directorate of Culture and of Cultural and Natural Heritage, Council of Europe, Strasbourg: 25-26.
- Sato Y., Taira R. and Mori Y. (2005). Tree rubbing by Hokkaido brown bears: seasonal changes in frequency, differences between genders, and a role of immigrants. In: Dalpiaz D. and Genovesi P. (eds.). *16th International Conference on Bear Research and Management – abstracts, program, information*. Provincia Autonoma di Trento a Istituto Nazionale Fauna Selvatica, Trento: 144.
- Schwartz C.C., Keating K.A., Reynolds H.V., Barnes V.G. Jr., Sellers R.A., Swenson J.E., Miller S.D., McLellan B.N., Keay J., McCann R., Gibeau M., Wakkinen W.F., Mace R.D., Kasworm W., Smith R. and Hererro S. (2003). Reproductive maturation and senescence in the female brown bear. *Ursus* **14(2)**: 109–119.
- Şelaru N. and Ionescu O. (2005). Stav a manažment hnedého medveďa v Rumunsku. (Status and management of the brown bear in Romania.) In: *Zborník referátov z medzinárodnej konferencie Levice, 12.03.2005*. Výskumný ústav živočíšnej výroby, Nitra: 27-34. (in Slovak.)
- Servheen C. (1989). The status and conservation of the bears of the world. International Association for Bear Research and Management. URL: <http://www.bearbiology.org/bearstatus.htm>
- Servheen C., Herrero S. and Peyton B. compilers (1999). *Bears. Status survey and conservation action plan*. IUCN Gland, Switzerland and Cambridge, UK: x + 309 pp.
- Sillero-Zubiri C. and Laurenson M.K. (2001). Interactions between carnivores and local communities: conflict or co-existence? In: *Carnivore Conservation*. Gittleman J.L., Funk S.M., Macdonald D. and Wayne R.K. eds. Cambridge University Press, Cambridge: 282-312.
- Sládek J. (1969). Economic management of brown bear (*Ursus arctos*) in Czechoslovakia. *Ochrana fauny* **3(1)**: 7-13.
- Sládek J. (1991). Určovanie veku ulovených medveďov hnedých pomocou histologických štruktúr zubov. (Determination of the age of the brown bear using histological structures of teeth.) *Folia Venatoria* **21**: 211-219. (in Slovak with English summary.)
- Sládek J. (1992). Možnosti rozlišovania pohlavia a veku medveďa hnedého podľa lebkových a zubných znakov. (Possibilities for distinguishing sex and age of brown bear by crane and teeth characters.) *Folia Venatoria* **24**: 175-190. (in Slovak with English summary.)

- Slávik D. (1989). Príklad hodný nasledovania. (An example of a worthy pursuit.) *Chránené územia Slovenska* **12**: 71. (in Slovak.)
- Slivinský J. (2001). Nájdenie opusteného medvedľaťa. (The finding of an abandoned bear cub.) *Chránené územia Slovenska*. **47**: 17-18. (in Slovak.)
- Slobodjan A.A. (1979). *K ekologii burogo medveda w Karpatach. Ekologičeskiye osnovy ochrany i racionalnogo ispolzovania chiščnych mlekopitajuščich.* (On the ecology of the brown bear in the Carpathians. Ecological basis of protection and rational exploitation of predaceous mammals.) AN SSSR. Izdat. Nauka, Moskwa: 233-235. (in Russian.)
- SMOPAJ (2006). Prehľad osobitne chránených častí prírody a krajiny v Slovenskej republike, stav k 31.12.2005. (Overview of individually protected components of nature and landscape in the Slovak Republic, state as of 31.12.2005.) *Chránené územia Slovenska* **67**: 2-3. (in Slovak.)
- Sommer R.S. and Benecke N. (2005). The recolonization of Europe by brown bears *Ursus arctos* Linnaeus, 1758 after the Last Glacial Maximum. *Mammal Review* **35**: 156-164.
- Somorová H. (1997). Kým povolia výnimku. (By the time they permit an exception.) *Poľovníctvo a rybárstvo* **49(10)**: 10-11. (in Slovak.)
- Steyaert S. (2006). Seed dispersal through endozoochory by red deer (*Cervus elaphus* L.) and brown bear (*Ursus arctos* L.) in the Polana Biosphere Reserve, Slovakia. Masters thesis. Wageningen University, Wageningen. 87 pp.
- Støen O.G., Bellemain E., Sæbø S. and Swenson J.E. (2005). Kin-related spatial structure in brown bears *Ursus arctos*. In: Dalpiaz D. and Genovesi P. (eds.). *16th International Conference on Bear Research and Management – abstracts, program, information.* Provincia Autonoma di Trento a Istituto Nazionale Fauna Selvatica, Trento: 29.
- Støen O.-G., Zedrosser A., Wegge P. and Swenson J. (2006). Socially induced delayed primiparity in brown bears *Ursus arctos*. *Behav. Ecol. Sociobiol.* **61**: 1-8.
- Sumiński P. (1976). Postavenie veľkých mäsožravcov (*Carnivora*) v poľovnom hospodárstve Poľskej ľudovej republiky. (The position of large carnivores (*Carnivora*) in hunting management in the People's Republic of Poland.) *Folia Venatoria* **5-6**: 351-362.
- Swenson J.E. (2005). Harvesting bears: do we understand what we are doing? In: Dalpiaz D. and Genovesi P. (eds.). *16th International Conference on Bear Research and Management – abstracts, program, information.* Provincia Autonoma di Trento a Istituto Nazionale Fauna Selvatica, Trento: 47-48.
- Swenson J.E., Sandegren F., Björvall A., Söderberg A., Wabakken P. and Franzén R. (1994). Size, trend, distribution and conservation of the brown bear *Ursus arctos* population in Sweden. *Biological Conservation* **70**: 9-17.
- Swenson J.E., Sandegren F., Söderberg A., Björvall A., Franzén R. and Wabakken P. (1997a). Infanticide caused by hunting of male bears. *Nature* **386**: 450-451.
- Swenson J.E., Sandegren F., Brunberg S. and Wabakken P. (1997b). Winter den abandonment by brown bears *Ursus arctos*: causes and consequences. *Wildl. Biol.* **3**: 35-38.
- Swenson J.E., Franzén R., Segeström P. and Sandegren F. (1998a). On the age of self-sufficiency in Scandinavian brown bears. *Acta Theriologica* **43(2)**: 213-218.
- Swenson J.E., Sandegren F., Söderberg A. (1998b). Geographic expansion of an increasing brown bear population: evidence for presaturation dispersal. *J. Anim. Ecol.* **67**: 819-826.
- Swenson J.E., Dahle B., Gerstl N. and Zedrosser A. (2000). *Action plan for the conservation of the brown bear in Europe (Ursus arctos).* Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention), Nature and environment, No.114, Council of Europe Publishing, Strasbourg.
- Swenson J.E., Sandegren F., Brunberg S. and Segerström P. (2001a). Factors associated with loss of brown bear cubs in Sweden. *Ursus* **12**: 69-80.

- Swenson J.E., Dahle B. and Sandegren F. (2001b). Intraspecific predation in Scandinavian brown bears older than cubs-of-the-year. *Ursus* **12**: 81-92.
- Šebo M. (2003). Problematika a riešenia regulácie veľkých šeliem a návrh postupu získavania dokumentácie škôd a úrazov spôsobených veľkými šelmami na Slovensku a v zahraničí a návrh systému riešení na ich zníženie. (The issue and solution of regulating large carnivores and a proposal for obtaining documentation of damage and injuries caused by large carnivores in Slovakia and abroad and a proposed system for reducing them.) *Slovak Hunting Union, Ilava*. 6 pp. (in Slovak.)
- Šebo M. (2004). Úrazy spôsobené medveďom. (Bear-caused injuries.) *Poľovníctvo a rybárstvo* **56(11)**: 10-11. (in Slovak.)
- Šprocha J. (1977). Stav medveďov na Slovensku. (The status of bears in Slovakia.) *Poľovníctvo a rybárstvo* **19(11)**: 19. (in Slovak.)
- Taberlet P. and Bouvet J. (1994). Mitochondrial DNA polymorphism, phylogeography, and conservation genetics of the brown bear *Ursus arctos* in Europe. *Proc. R. Soc. Lond.* **255**: 195-200.
- Tallmon D.A., Bellemain E., Swenson J.E. and Taberlet P. (2004). Genetic monitoring of Scandinavian brown bear effective population size and immigration. *J. Wildl. Manage.* **68(4)**: 960-965.
- Teren Š. (1987a). *Po stopách vzácnej zveri. (On the tracks of rare game.)* Obzor, Bratislava. 184 pp. (in Slovak with English summary.)
- Teren Š. (1987b). *Tatranská medvedica. (A Tatra she-bear.)* Príroda, Bratislava. 89 pp. (in Slovak.)
- Treves A. and Naughton-Treves L. (2005). Evaluating lethal control in the management of human-wildlife conflict. In: *People and wildlife: conflict or coexistence?* Woodroffe R., Thirgood S. and Rabinowitz A. eds. Cambridge University Press, Cambridge: 86-106.
- Uhrin M. (2000). Čo s medved'at'om? (What to do with the bear cub?) *Národné Parky* **2000(2)**. (in Slovak.)
- Urban P. (1995). Výskum a ochrana cicavcov na Slovensku. (Research and conservation of mammals in Slovakia.) *Chránené územia Slovenska* **26**: 20-21. (in Slovak.)
- Urban P. (2000). Emerald, Natura a veľké šelmy. (Emerald, Natura and large carnivores.) *Chránené územia Slovenska* **46**: 22-24. (in Slovak.)
- Urban P. (2001). Čo s opustenými mláďatami medveďa hnedého, alebo štyri prípady a viacero otázok 4. Niekoľko námetov na prípadnú diskusiu. (What to do with abandoned brown bear cubs, or four cases and more questions 4. Some themes of the prospective discussion.) *Chránené územia Slovenska* **48**: 18-19. (in Slovak.)
- Urban P. (2002). Smernica rady európskych spoločenstiev o ochrane prírodných biotopov, voľne žijúcich živočíchov a voľne rastúcich rastlín a cicavce Slovenska. (Directives of the Council of the European Community on the protection of habitats, wild fauna and wild flora and mammals of Slovakia.) In: *Výskum a ochrana cicavcov na Slovensku* V. Urban P. ed. Štátna ochrana prírody, Banská Bystrica: 9-18. (in Slovak with English summary.)
- Ursíny J., Stolzová Sutorisová M. (1970). *Besnota. (Rabies.)* Príroda, Bratislava. (in Slovak.)
- Vaisfeld M.A. (2005). Brown bear of the north Caucasus mountain ecosystem with regards to current social-economic situation. In: Dalpiaz D. and Genovesi P. (eds.). *16th International Conference on Bear Research and Management – abstracts, program, information.* Provincia Autonoma di Trento a Istituto Nazionale Fauna Selvatica, Trento: 157.
- Vaisfeld M.A. and Chestin I.E. eds. (1993). *Bears (brown bear, polar bear, Asian black bear): distribution ecology, use and protection.* Nauka, Moscow.
- Valdmann H., Saarma U. and Karis A. (2001). The brown bear population in Estonia: current status and requirements for management. *Ursus* **12**: 31-36.

- Viestová E. (2003). Slovakia. In: *Progress on preparation for Natura 2000 in future EU member states*. Beckmann A. ed. WWF: 49-52.
- Voskár J. (1993). Ekológia vlka obyčajného (*Canis lupus*) a jeho podiel na formovaní a stabilite karpatských ekosystémov na Slovensku. (The ecology of the wolf (*Canis lupus*) and its share in the formation and stability of Carpathian ecosystems in Slovakia.) *Ochrana prírody* **12**: 241-276. (in Slovak.)
- Waits L., Paetkau D. and Strobeck C. (1999). Genetics of the bears of the world. In: *Bears. Status survey and conservation action plan*. Servheen C., Herrero S. and Peyton B. compilers. IUCN Gland, Switzerland and Cambridge, UK: 25-32.
- Weber P. (1987). Observations of brown bear movements in the Hargita Mountains, Romania. *Int. Conf. Bear Res. and Manage.* **7**: 19-21.
- Wechselberger M., Rigg R. and Beťková S. (2005). *An investigation of public opinion about the three species of large carnivore in Slovakia: brown bear (Ursus arctos), wolf (Canis lupus) and lynx (Lynx lynx)*. Slovak Wildlife Society, Liptovský Hrádok. x + 89 pp.
- Witkowski Z.J., Król W. and Solarz W. eds. (2003). *Carpathian list of endangered species*. WWF and Institute of Nature Conservation, Polish Academy of Sciences, Vienna-Krakow. 64 pp.
- Woodrooffe R., Thirgood S. and Rabinowitz A. (2005). The impact of human-wildlife conflict on natural systems. In: *People and wildlife: conflict or coexistence?* Woodrooffe R., Thirgood S. and Rabinowitz A. eds. Cambridge University Press, Cambridge: 1-12.
- Zacharová J. (2006). NATURA 2000 – stratégia implementácie smernice o vtákoch a smernice o biotopoch na roky 2005-2013 v podmienkach MŽP SR. (Natura 2000 – implementation strategy of the Birds Directive and Habitats Directive in 2005-2013 under Environment Ministry conditions.) *Chránené územia Slovenska* **67**: 12-17. (in Slovak.)
- Zedrosser A., Rauer G. and Kruckenhauser K. (2004). Early primiparity in brown bears. *Acta Theriologica* **49(3)**: 427-432.
- Zięba F. and Kozica T.W. (2005). *On, czyli prawie wszystko o tatrzańskim niedźwiedziu. (The Tatran brown bear (Ursus arctos).)* Tatrzański Park Narodowy, Zakopane. 120 pp. (in Polish with English summary.)
- Žiak D. and Urban P. (2001). Červený (ekosozologický) zoznam cicavcov (Mammalia) Slovenska. (Red list of mammals (Mammalia) of Slovakia.) In: *Červený zoznam rastlín a živočíchov Slovenska. (Red list of plants and animals of Slovakia.)* Baláž D., Marhold K. and Urban P. (eds.). *Ochrana prírody* **20** (Suppl.): 154-156.
- Žilincár J., Zvada P. and Hell P. (1992). Die Schwermetallbelastung bei den Braunbären in den Westkarpaten. (The presence of heavy-metals in brown bears in the West Carpathian mountains.) *Z. Jagdwiss* **38**: 235-243. (in German.)
- Žilinec M. (1987). Ustúpi človek alebo medveď? (Will man or bear step back?) *Chránené územia Slovenska* **9**: 7-8. (in Slovak.)

APPENDICES

Appendix I

IUCN action plan recommendations and implementation

Actions recommended in Hell and Find'o (1999)	Implementation by 2006
1. <i>Improving the population monitoring used for management so that favourable numbers, sex ratios, and age structures can be maintained.</i>	Large-scale census or year-round monitoring in some protected areas.
2. <i>Killing only problematic, habituated individuals.</i>	No.
3. <i>With the privatisation of hunting grounds, it will be necessary to increase the state supervision of the management of bear populations.</i>	Checks on observance of regulations have been tightened since 1994.
4. <i>Limiting the hunting of bears near the borders of their range.</i>	In general yes but some exceptions (e.g. to prevent range expansion to the southwest).
5. <i>Co-operating closely with Polish authorities and possibly also with Ukraine (Sub-Carpathian Ukraine) in conservation and management of bears.</i>	No.
6. <i>Ensuring further compensation for damages caused by bears.</i>	Yes, though were initial problems with funding for damage to crops and orchards.
7. <i>Supporting the introduction of complex biological and technical damage control measures.</i>	According to law, payment of compensation is linked to use of preventive measures, though implementation is unsystematic.
8. <i>Improving the management of habitats and important food sources for bears, designating certain localities rich in forest fruits inaccessible to the public.</i>	Zoning of National Parks in preparation.
9. <i>Publishing information for visitors in bear areas, giving guidelines on appropriate behaviour in close range encounters.</i>	NGOs more active than state organisations.
10. <i>Continuing scientific studies of bears in the West Carpathians (including radio-tracking etc.), and supporting it with both ideological and financial support of international conservation organisations.</i>	Studies of bear ecology and bear-human conflicts by Slovak Wildlife Society. Genetic research underway. Radio-tracking by Polish researchers.

Appendix II

Council of Europe action plan recommendations and implementation

Actions recommended in Swenson et al. (2000)	Implementation by 2006
4.1.2 <i>Establishment of national brown bear management groups and management plans (countries sharing populations produce management plans co-operatively).</i>	Group failed to complete plan before stopped meeting; inadequate international co-operation.
4.3.1 <i>Classification of areas within present and possible bear range according to their suitability and importance as habitat for bear management.</i>	Partially, as part of work to establish network of Natura 2000 sites.
4.3.2 <i>Identification and maintenance or recreation of linkage zones in fragmented populations.</i>	Inadequate.
4.3.3 <i>Evaluation of impact of existing and planned infrastructure on bear habitat and mitigation of negative impact.</i>	Inadequate.
4.3.4 <i>Control or prohibition of human activities detrimental in bear core areas and linkage zones.</i>	Existing protected area network, Natura 2000.
4.4.2 <i>Link of compensation system to individual farmer's use of preventive measures.</i>	Included in law but measures not effective.
4.4.3 <i>Inaccessibility of garbage dumps and human waste for brown bears.</i>	Some local measures; Slovak Wildlife Society project.
4.5.1 <i>Minimise the creation of problem bears e.g. by establishing compensation programmes with built-in measures to minimise cheating; abandoning artificial feeding that may create human habituated bears.</i>	Partial. Attractants (e.g. accessible refuse) often not removed after shooting problem bear.
4.5.2 <i>Removal of problem bears in viable populations if preventive efforts have failed.</i>	Yes but not always done promptly.
4.6.1 <i>Identification and involvement of public opinion leaders and stakeholders in brown bear management.</i>	Some in management group when met.
4.7.1 <i>Initiate information campaigns designed for different target groups.</i>	Slovak Wildlife Society project.
4.8.1 <i>Co-ordinated scientific research on brown bears in Europe</i>	Very little good scientific research in Slovakia.
4.8.2 <i>Co-ordination of gathering necessary data to monitor management and biological conditions of brown bears in European countries.</i>	State and Slovak Wildlife Society participation e.g. at LCIE meetings.

Appendix III

Nuisance bear conference recommendations and implementation

Actions recommended in Rigg and Baleková (2003)	Implementation by 2006
<u>Environment Ministry and Agriculture Ministry</u>	
<i>Establish bear management zones.</i>	Partial: Natura 2000, hunting excluded from National Park core areas.
<i>Implement large-scale censuses and year-round monitoring of large carnivores.</i>	In some protected areas.
<i>Allocate annual funding to deal with nuisance bears.</i>	On <i>ad hoc</i> basis.
<i>Deal with the issue of waste and include consideration of bears in an amendment to the law on waste management.</i>	No.
<u>Local self-governments in areas of brown bear occurrence</u>	
<i>Prepare effective systems of communal waste collection, storage, transport and disposal, with reference to bears.</i>	Some local measures.
<u>State Nature Conservancy organisations and environment administration authorities</u>	
<i>Check and where necessary sanction legal and physical bodies for breaching the decree on securing communal waste within the range of brown bear occurrence.</i>	No.
<i>Direct the picking of forest fruits which are part of natural bear diet so that it does not lead to a deficiency of such food in the range of bear occurrence.</i>	Provisions in law for protected areas, some enforcement by rangers, infringements common.
<u>Conservation organisations in co-operation with state authorities and organisations</u>	
<i>Conduct public education and awareness on issues of conserving large carnivores and their habitats.</i>	Slovak Wildlife Society's BEARS Project.
<i>Focus on the target group of owners and operators of lodges and facilities and tourists in brown bear range with the aim of reducing the likelihood of bears becoming human habituated or food-conditioned.</i>	Slovak Wildlife Society project <i>Waste Management and Bear Conservation in Slovakia</i> .
<i>Focus on the target group of livestock breeders and bee keepers to promote the use of effective preventive measures such as livestock guarding dogs and electric fences.</i>	Done by some protected area staff; Slovak Wildlife Society projects.

Appendix IV

Official procedures for planned population control (“regulation shooting”)

The following details are specified in the document, *Procedures of Nature and Landscape Protection Authorities and Organisations in Permitting Exceptions for the Killing of Brown Bear (Ursus arctos) and Grey Wolf (Canis lupus) Individuals in Slovakia*, approved on 29.1.1998.

Applying for exceptions

A written application for an exception from the law with the aim of controlling population numbers of the brown bear can be lodged by legal (physical) entities which have the right to conduct hunting until 31.1. of the respective calendar year in the respective hunting ground with brown bear occurrence. The application must contain:-

- full name of applicant;
- number and weight category of bears for which permission to shoot is sought;
- period and method of the planned hunt;
- location of bait and hunt (marked on 1:50,000 scale map);
- characteristics of hunting ground (HG);
- total area of HG;
- area of forest land and agricultural land in the HG;
- location of the HG in relation to protected areas;
- estimate of bear numbers in the HG according to sex and age;
- summary of bears shot in the last 5 years (number, sex, weight);
- reason(s) for application;
- if damage or increased numbers of bears is the reason for the application, a summary of damage during the preceding year to livestock and beehives within the respective HG and confirmed by the respective state hunting administration authority;
- 500 Sk (€14) application fee.

Assessing applications

Because planned population control has a range-wide impact on the bear population in Slovakia, after all applications are received the Environment Ministry designates a special commission with representatives of nature and landscape conservation authorities and organisations which assesses applications and proposes conditions for authorising exceptions from bear protection. The general criteria are:-

- (1) *Exceptions to be permitted in regard to the brown bear population in the whole of Slovakia or in geomorphological units or hunting regions.*
- (2) *Exceptions to be issued preferentially in localities where a higher level of damage to livestock and beehives was documented in the preceding year.*
- (3) *No “regulation shooting” to be permitted in protected areas of levels 3 to 5. Here, only “protection shooting” is to be preferentially permitted on the basis of current documented damage.*
- (4) *No hunt to be permitted on the eastern edge of the range with the exception of localities with documented damage.*
- (5) *The annual quota for number regulation is up to 10% of the estimated population of 600-800 individuals, i.e. 60-80 bears. The size of the quota for geomorphological units or hunting regions is to be set on the basis of results from field census or, if this has not been done, by calculating a 10% share from a mean population density of 1 bear per 1,524 ha (6.6 inds./100 km²).*
- (6) *Only individuals not exceeding 100 kg or with a front paw width up to 12 cm and rear paw length up to 21 cm will be the subject of “regulation shooting”.*
- (7) *Baiting is only with non-meat bait.*

(8) *“Regulation shooting” will only be permitted from 1.6. to 15.12.*

Issuing exceptions

On the basis of the commission's conclusions, the Environment Ministry department of Nature and Landscape Protection should issue a decision on exceptions for the killing of brown bears by 28.2. The conditions set in 2005 were:-

- (1) *Only individuals not exceeding 100 kg or with a front paw width up to 12 cm and rear paw length up to 21 cm shall be shot.*
- (2) *Locations of bait and shooting shall be agreed in advance in writing with the respective nature and landscape protection organisation.*
- (3) *Luring to a meat bait shall not precede bear hunting.*
- (4) *The planned time of the hunt or arrival of the guest shall be notified in advance.*
- (5) *A successful shooting shall be notified immediately to allow checks and examination of the shot bear.*
- (6) *The shot bear shall be left on site until the arrival of the nature and landscape protection contact person (who conducts measurements). Weight includes the internal organs. The representative of the applicant shall arrange means for weighing to an accuracy of 0.5 kg.*
- (7) *The applicant shall allow the contact person to take samples for analysis (fur, muscle, internal organs, blood, etc.).*
- (8) *The form “Notice of brown bear death” with details of the dead individual shall be sent to the Environment Ministry within 2 weeks of a successful hunt.*

The following are notified of decisions:-

- *the respective state Nature and Landscape Protection administration district authority;*
- *the respective state Nature and Landscape Protection administration county authority;*

- *the respective organisational units of State Nature Conservancy (protected area administrations);*
- *State Nature Conservancy head office.*
- *Slovak Environmental Inspectorate – the respective Nature Protection inspectorate.*
- *Other participants in the process.*

Successful applicants are reminded of the legal requirement to obtain agreement from the Environment Ministry for export of trophies from CITES-protected species.

Checking regulations are followed

In general, every exception includes a condition to call a representative of the Nature and Landscape Protection authority or organisation for the biometry of the shot bear. A further duty for the HG administrator is to notify the contact person mentioned in the exception of the arrival of the shooter who is to realise the killing (hunting) of the bear, allowing preparation time for going to the site.

SNC employees who are authorised members of the nature guard are also authorised to supervise adherence to the conditions of the decision. Employees of the Slovak Environmental Inspectorate also have this authorisation by law.

At the catch, a representative of the SNC carries out biometric measurements of the killed individual and sees to it that the shot individual is weighed (with entrails).

In case it is discovered that conditions for hunting have been violated, staff carrying out the check suggest an investigation by the Slovak Environmental Inspectorate or the respective Nature and Landscape Protection district authority.

Evaluating outcome

The Environment Ministry, department of Nature and Landscape Protection, with help from the SNC, should evaluate the filling of permits for bear population control by 31.1. of the following year.

Appendix V

Official procedures for paying compensation and removing problem bears

The following details are specified in the document, *Procedures of Nature and Landscape Protection Authorities and Organisations in Permitting Exceptions for the Killing of Brown Bear (Ursus arctos) and Grey Wolf (Canis lupus) Individuals in Slovakia*, as well as in pertinent laws.

Assessing damage

- (1) *The state reimburses damage caused by bears in hunting grounds where there is no bear hunting or where the institutor of the user is the state; in other cases damage is reimbursed by the user of the hunting ground.*
- (2) *The municipality in which a request for damage compensation originates conducts a site inspection to determine the extent and circumstances of the damage, with the participation of representatives from the District Office department of land, agriculture and forestry, the District Office department of the environment and the Slovak Hunting Union.*
- (3) *On the basis of the result of the site inspection, the District Office department of land, agriculture and forestry decides on appropriate compensation for the damage. Compensation is allowed if the damaged party proves that the damage was not his fault or that of the person entrusted with the care of domestic animals.*

State Nature and Landscape Protection administration authorities invite representatives of the respective Nature and Landscape Protection expert organisation to site inspections. They also ensure the following are recorded:-

- *site of damage;*
- *identity of damaged party;*
- *hunting ground;*

- *date and description of damage;*
- *proposal for measures to prevent the occurrence of subsequent damage;*
- *opinion of the state Nature and Landscape Protection administration authority on the occurrence of damage (including measures taken to prevent the occurrence of damage).*

Permitting removal of problem bears

A bear is considered to be a problem individual if:-

- *repeated damage has occurred at the same or a neighbouring location and the evidence or tracks found confirm (or do not exclude) that it concerns the same individual or group of bears;*
- *damage is recorded in the minutes of site inspections as described above.*

To allow the removal of nuisance bears, an exception from the law must be authorised by the Environment Ministry department of Nature and Landscape Protection. The damaged party can apply directly. To facilitate rapid decisions, applications can be made by fax or e-mail and the Environment Ministry should settle applications that contain all the required information within 3 days.

The following conditions are set for the shooting of nuisance bears:-

- *the bear is in the act of committing damage and is shot in the presence of an employee of the respective Nature and Landscape Protection expert organisation;*
- *as far as possible shooting is done by employees of the forestry service.*
- *biometry should be carried out on the shot bear.*

Appendix VI

Assessment criteria for the brown bear defined by the State Nature Conservancy in its manual for a programme of care of Natura 2000 sites and species

Assessment criteria	Favourable status		Unfavourable status
	A - good	B – average	C – unfavourable
Population			
1.1. Population size / density	>800 individuals in Slovakia or >10 inds./100 km ² in core areas.	500-800 individuals in Slovakia or 5-10 inds./100 km ² in core areas.	<500 individuals in Slovakia or < 5 inds./100 km ² in core areas.
1.2. National and local trend	Population size or density increasing by more than 20%.	Population size and density stable, natural fluctuations \pm 20%.	Population size or density decreasing by more than 20%.
1.3. Distribution trend	Distribution increasing by more than 20%.	Distribution stable, slight fluctuations of \pm 20%.	Distribution decreasing by more than 20%.
1.4. Population structure	Proportion of cubs of the year and individuals 12+ years old both >20%.	Proportion of cubs of the year and individuals 12+ years old both 10-20%.	Proportion of cubs of the year and individuals 12+ years old both <10%.
	Proportion of females with cubs >15%.	Proportion of females with cubs 10-15%.	Proportion of females with cubs <10%.
1.5. Litter size	Average >2.0 / female.	Average 1.5-2.0 / female.	Average <1.5 / female.
Habitat			
2.1. Breeding habitat	Mostly mixed and coniferous forests in montane areas with cliffs, blow-downs and other shelter next to felled areas.	Mostly beech, mixed and coniferous forests in sub-montane and montane areas with cliffs, blow-downs and other shelter next to felled areas.	Mostly not beech, mixed and coniferous forests in sub-montane and montane areas with cliffs, blow-downs and other shelter next to felled areas.
2.2. Feeding habitat	Mostly open sites, felled areas and forests in montane areas.	Mostly open habitats, felled areas and forests in sub-montane and montane areas.	Mostly not open habitats, felled areas, sub-montane and montane forests.
Threat			
3.1. Threat to species	No hunting.	Regulated hunting.	Intensive persecution and hunting.
3.2. Threat to breeding and feeding habitat	No disturbance, fragmentation or destruction of original mixed and coniferous forest in montane areas with cliffs, blow-downs and other shelter next to felled areas; increase in such habitats.	Disturbance, fragmentation or destruction of <10% of beech, mixed and coniferous forests in sub-montane and montane areas with cliffs, blow-downs and other shelter next to felled areas; or compensation for the proportion of such habitats.	Disturbance, fragmentation or destruction of >10% of beech, mixed and coniferous forests with shelter next to felled areas in sub-montane and montane.



Abbreviations

BEARS Project	Bear Education, Awareness and Research in Slovakia
CEI/CERI	Carpathian Ecoregion Initiative
CIC	Conseil International de la Chasse
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
EIA	Environmental Impact Assessment
EU	European Union
EU-15	Member countries of the European Union before expansion in 2004
EU-25	Member countries of the European Union following expansion in 2004
IUCN	World Conservation Union
LCIE	Large Carnivore Initiative for Europe
NECONET	National Ecological Network
NGO	Non-government organisation
NP	National Park
PEBLDS	Pan-European Biological and Landscape Biodiversity Strategy
PEEN	Pan-European Ecological Network
PLA	Protected Landscape Area
SAC	Special area of conservation
SCI	Site of Community importance
SNC	State Nature Conservancy of the Slovak Republic
TANAP	Tatranský (Tatras) National Park
TRAFFIC	Trade Records Analysis of Flora and Fauna in Commerce
TSES	Territorial System of Ecological Stability
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
WWF	World Wide Fund for Nature

