



## New insights into the dynamics of hybridization between wolves and dogs

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Hybridization between wolves and dogs has been considered mostly anecdotal in the last few decades and its possible relevance neglected. This view resulted from a combination of a priori ideas about the biology of wolves and dogs, as well as from a very limited amount of genetic and genomic data available for both wild and domestic populations. However, recent developments in genomic technologies and a more careful observation of natural populations suggest that hybridization between wolves and dogs has been much more frequent than previously thought. On one hand, the analysis of full sequenced genomes for critically relevant samples indicates the common occurrence of past hybridization since the advent of dog domestication, and clearly rejects a simple scenario of reproductive isolation between both forms. On the other hand, the careful monitoring of wolf populations in human-dominated landscapes together with new and more powerful genetic techniques to identify ongoing hybridization are changing our views on the prevalence and importance of this process. In this presentation I offer a review on important data that were recently made available, providing new insights into the dynamics of hybridization between wolves and dogs. In addition, I speculate about its possible importance for the evolution of wolf populations and also discuss conservation implications.



## Genetic monitoring of wolves in Slovenia

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Monitoring of wolves is critical for their management and conservation, especially in heavily persecuted populations like the one in Slovenia. Robust monitoring of this species has long been an elusive goal, but with the new methods utilizing noninvasive genetic samples and mark-recapture modeling this is rapidly changing.

We designed and implemented a large-scale, intensive noninvasive genetic study of wolves in Slovenia in years 2010-2013. We timed the sampling seasons according to reproductive biology of the species, and used mark-recapture simulations to scale the sampling effort. The study was designed as a “robust design”, with three yearly sampling seasons during which the population is assumed to be demographically closed, and assuming a demographically open population between the seasons to obtain three independent population size estimates, as well as an estimate of emigration/mortality and immigration/fecundity. We used parentage analysis to disentangle immigration from fecundity.

We collected ~500 noninvasive genetic samples in each season, and successfully obtained a wolf genotype from close to 50% of samples. We used 11 polymorphic microsatellite markers for individual ID, and extended the panel to 36 microsatellite markers for parentage and relatedness analyses. Apart from non-amplifying samples, we had a considerable number of fox and domestic dog samples driving down wolf-genotyping the success rates. Nevertheless, we managed to obtain a close to 3.5 recapture rate in every season, and highly precise population size estimates.

We saw that despite high culling the number of wolves remained relatively stable between years, but with a very high population turnover. We speculate that the fact that the wolves in Slovenia are actually the NW edge of the Dinaric wolf population helps dampen the effects of high culling. Noninvasive genetics is providing an unprecedented, pack-level insight into population dynamics of wolves and should be the method of choice for future monitoring programs.



## Conservation genetics and genomics of the Italian wolf population

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Wolves in Italy are sharply divergent from and have lower genetic variability than other populations worldwide. Nevertheless they are expanding rapidly, recolonizing their historical ranges in the Apennines and western Alps. Connections among Italian and Dinaric wolves are ongoing. Wolf x dog hybridization is a major threat caused by widespread free-ranging dogs in human-dominated regions. Wolf genetic and demographic structure was studied during the last 10 years in a large sector of the Apennines by non-invasive genetic methods. More than 5.000 biological samples (scats; tissues, blood, urines) were genotyped and sexed using 12 unlinked autosomal microsatellites (STR), 4 Y-linked STRs and a diagnostic mtDNA sequence. We identified 414 wolves, 88 dogs and 16 putative hybrids (3.9%). Kinship analyses led to identify 42 packs with multi-generation genealogies, which are used to estimate demographic parameters (average pack size =  $5.55 \pm 2.44$  SD; minimum home range =  $74.34 \pm 51.69$  km<sup>2</sup>; average number of pups/pack =  $2.36 \pm 1.96$ ). There were 37 dispersers, 14 of which became breeders in new or existing packs. Population size was  $N = 117$  to 233 in different years, as estimated by CMR modelling. Turnover of breeding pairs, determined by immigrants or within-pack replacements, involved 19% of the packs. The population was not inbred, reproductive wolves were unrelated and new packs were founded by unrelated dispersers, except one pack founded by a brother-sister pair. Most of hybrids (in part analysed using 39 STRs) were backcrosses and were assigned to the packs, indicating that hybridization was most frequent in the past 3-4 generations. Some hybrids have Y or mtDNA haplotypes of dog origins, suggesting less stringent mating asymmetry than previously supposed. Functional genes ( *$\beta$ -defensin*, MHC, OR) are used to investigate the occurrence of coat-colour variants and patterns of introgression. Within collaborative networks, the genomes of two Italian wolves have been completely sequenced and analyzed to reconstruct past demography and patterns of deep introgression. Representatives of the main European wolf populations, village dogs and hybrids have been genotyped with the Illumina 170K SNP-chip. Shared genomic database will greatly deepen the contributions of population genetics to wolf conservation in Europe.



## Preliminary study of wolf packs stability based on genetic data

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While there is considerable work done on social structure of wolves in strictly protected populations and in various captivity settings, less is known about behavioral reactions of this species in persecuted populations, especially about pack reactions to high culling pressure.

We used noninvasive genetic sampling and genotyping of dead wolves to study the heavily persecuted wolf population in Slovenia. We genetically tracked all current packs in the country for three consecutive years with high-intensity noninvasive genetic sampling. We also genotyped tissue samples of all wolf mortality in Slovenia over the last decade. Each detected individual was genotyped using a panel of 36 polymorphic microsatellite loci, and included in parentage and relatedness analysis.

We managed to reconstruct the social structure of all wolf packs, and pedigrees for a majority of animals. Although the wolf is a monogamous species, heavy persecution and loss of reproductive animals makes a typical reproductive animal change several partners during its lifetime. We also witnessed packed dispersals caused by losses of reproductive animals. We also found several “missing” reproductive (territorial) animals, pointing at undetected mortality, of which at least a part is probably poaching.

Although it seems that a wolf population can numerically compensate a considerable culling pressure, the impact on the social structure is high. This should be taken into account in populations where culling is used as a conservation and regulation measure.



## Genetic composition of the Czechoslovakian Wolfdog

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**Abstract :** Hybridization between wolf and its domestic form is interesting topic from the view of primary research and conservation biology. In 1950's, experimental crossbreeding between wolves (*Canis lupus lupus*) and German shepherd dogs has begun in kennel "Z pohraniční stráže" in Libějovice in the Czech Republic. The aim of the hybridization was to obtain individuals with high temperament, good physiological and sensorial attributes and controllability. Four individuals of wolves (two males, two females) were used for crossbreeding during thirty years. This experiment finally led to creation of new Czech national breed named the Czechoslovakian Wolfdog. The breed was officially accepted by the Fédération Cynologique Internationale in 1989. In this study, we aim to obtain basic descriptive parameters of the breed, compare the results with existing pedigrees and contribute to the topic of discrimination of wolfs, dogs and their hybrids using analytical tools of current population genetics. We collected buccal swabs from 78 individuals of Czechoslovakian Wolfdogs and 20 individuals of German shepherds. Comparative data from 20 wolves were used from projects ongoing in cooperation with Duha movement and other organizations. Faeces samples of wolves were collected in the Western Carpathians. Despite low number of founding individuals, inbreeding coefficient in Czechoslovakian Wolfdog's population was lower (0,0222) than expected according to the pedigree and no significant difference was detected between observed and expected heterozygosity. No internal structure was detected among Czechoslovakian Wolfdogs. For discrimination between particular lineages, explanatory power of different number of microsatellite loci (19 and 38) was assessed. Particular breeds and pure wolf population were very well recognized and distinguished by Bayesian clustering analyses and other methods. The analyses also confirmed relatively low proportion of wolf genome concordant with pedigree data. Complete data set analysis didn't show considerable presence of dog alleles in Western Carpathian wolves genotypes, therefore it can be assumed that currently there is no dog and wolf hybridization occurrence in the sampled area or respective gene flow is very low.

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## Shoot, shovel and shut up: cryptic poaching slows restoration of a large carnivore in Europe

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Poaching is a widespread and well-appreciated problem for the conservation of many threatened species. Because poaching is illegal, there is strong incentive for poachers to conceal their activities, and consequently, little data on the effects of poaching on population dynamics are available. Quantifying poaching mortality should be a required knowledge when developing conservation plans for endangered species but is hampered by methodological challenges. We show that rigorous estimates of the effects of poaching relative to other sources of mortality can be obtained with a hierarchical state-space model combined with multiple sources of data. Using the Scandinavian wolf (*Canis lupus*) population as an illustrative example, we show that poaching accounted for approximately half of total mortality and more than two-thirds of total poaching remained undetected by conventional methods, a source of mortality we term as 'cryptic poaching'. Our simulations suggest that without poaching during the past decade, the population would have been almost four times as large in 2009. Such a severe impact of poaching on population recovery may be widespread among large carnivores. We believe that conservation strategies for large carnivores considering only observed data may not be adequate and should be revised by including and quantifying cryptic poaching.



## Pack variation in feeding ecology in northern Dinaric wolves

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Wolf diet from northern Dinaric wolf population was studied in an area of 5800 km<sup>2</sup> occupied by 8 to 11 packs between 2010 and 2012 using indirect method of scat analysis. Pack affiliation was determined for all sampled scats using telemetry data on pack territories and/or genetic information on parentage analysis. The study aims to address variation in diet composition of main wild ungulate prey species (red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*) and wild boar (*Sus scrofa*)) and livestock between packs or groups of adjacent packs in three regions (Kočevska, Notranjska and Primorska regions). Relations between wild ungulate densities, small cattle (sheep and goat) abundances, wolf's diet and livestock depredation rates were studied. We used frequency of occurrence (F.O.) in wolf scats. Estimates of relative wild ungulate population densities were obtained from harvest/mortality statistics plotted in 1 km grids. National statistic data on small cattle and land-use were used to calculate small cattle availability for particular wolf pack or region. Diet composition was compared between livestock grazing (Apr, May – Oct, Nov) and non-grazing (Oct, Nov – Mar, Apr) seasons as well as between three periods in relation to pup-rearing period and subsequent pack mobility (early pup-rearing period May-Aug, late pup period Sep-Dec, nomadic period Jan-Apr). Among wild prey species, cervids (red deer and roe deer) and wild boar, were the main prey of wolves in all studied packs ranged from 78 % to 98 % (F.O.) in their diet. However there was largest variation of cervids in their diet between packs ranged from only 35 % to over 83 %. Wild boar ranged from 17 % to 39% in overall diet between packs or pack groups. There was a positive correlation between red deer densities and occurrence of cervids in the wolves' diet. Wolves preyed on wild ungulates more in Kočevsko and in Notranjska region than in the Primorska region; the contrary was the case for livestock. Livestock (sheep and goats in 99 %) represented 1.9 % to 22.2 % in the diet of particular wolf pack. In two packs studied in Primorska region, small cattle occurred in high proportions 12.9 % and 22.2% despite comparable overall wild ungulate densities (harvest proxy– 2.62 ungulates/km<sup>2</sup>) to the other two regions (Kočevsko 2.79 ungulates/km<sup>2</sup> and Notranjska 2.34 ungulates/km<sup>2</sup>), but with lower red deer density (harvest: 0.21 red deer/km<sup>2</sup> versus 1.22 red deer/km<sup>2</sup> and 0.77 red deer/km<sup>2</sup>). As expected, during grazing season livestock occurred in diet in higher proportions compared to non-grazing season, however in Primorska region where grazing season may be largely extended in spring and autumn, livestock remain high all year round.





## Global patterns in home site selection by wolves

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It is well-known that wolves occur in a wide range of ecological situations, being usually considered as a habitat generalist. However, from a global perspective, this ecological plasticity has not yet been assessed at particular levels of habitat selection associated to key periods of its biological cycle such as the selection of home sites during the breeding period. This behaviour is crucial for the pack due to the spatio-temporal vulnerability of all its members during a remarkable period of time (ca. 6 months). We combined a systematic literature review with field data to study habitat selection of home sites by wolves, including both den and rendez vous sites. Overall, 12 study areas were considered and 190 habitat variables were subjected to meta-analysis. All variables were classified according to their ecological interpretation into the following seven factors: accessibility, direct and indirect human vulnerability, macrohabitat refuge, positive and negative microhabitat refuge and water availability. For each variable we calculated the Hedge's *g* value as a measure of effect size. Weighted average effect sizes and 95% bias-corrected bootstrap confidence limits for the mean effect size were used to test for significant influence of each factor in home site selection by wolves. Our results indicate that wolves tend to select home sites located near water sources and with low exposure to humans (both direct and indirect vulnerability). Refuge in terms of vegetation structure may play a secondary role on a broader scale, being context-dependent, while vegetation and habitat structure in the immediate surroundings could reflect the fact that pups are kept in places where they are hardly detected and go unnoticed at short distances. We discuss how management plans and statements integrate this level of selection in order to assess whether the current management of the species envisage the protection of existing and potential breeding areas. We stress that management strategies should focus greater attention on habitat availability during the critical breeding period, and this factor should be considered by sectoral policies with potential to interfere with the unveiled home site habitat requirements.





## Space use by wolves, lynx and cervids in Gorski kotar, Croatia

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Space use of wolves, lynx, red deer and roe deer was determined from telemetry locations of five wolves (5716 locations), six lynx (1579 locations), four red deer (234 locations) and seven roe deer (694 locations) tracked by GPS and VHF collars in the same part of Gorski kotar, Croatia. Animal locations were assigned to habitat parameters and compared with each other and with random locations. All tracked cervids preferred to stay in the forest (89 % of locations) and not on meadows, on lower elevations (825 m vs. mean of 882 m) and significantly closer (851 m vs. 1135 m) to feeding sites. Red deer spent 90% time in the forest, while roe deer stayed 1.6% less in forest compared to red deer. Roe deer were found in areas with higher road density than red deer (1.14 vs. 0.84 km/km<sup>2</sup>). Roe deer were found on lower elevations (786.6 m asl.) and considerably closer to feeding sites compared to red deer (757 m vs. 1202 m). Wolves stayed at significantly higher elevations than random locations (1051 m vs. 882 m), but avoided steep slopes (11.2 deg., vs. 12.8 deg). Wolves stayed closer than random to roads (269 m vs. 377 m) and closer to deer feeding sites (2600 m vs. 4333 m). Wolves stayed at places with greater forest cover (92.2% vs. 84.6%) and with lower human density (0.09/km<sup>2</sup> vs. 22.8/km<sup>2</sup>). Lynx stayed on significantly higher elevations (952 m vs. 791 m), with lower human density (0.00/km<sup>2</sup>), on steeper slopes (14.8 deg vs. 12.8 deg) and also significantly farther from roads (506 m vs. 377 m), but closer to deer feeding sites (2226 m vs. 4333 m). Wolves stayed at significantly higher elevations compared to lynx, but lynx locations were at steeper (14.8 deg) slopes compared to wolf locations (11.2 deg). Lynx stayed significantly farther from roads, compared to wolves, but closer to deer feeding sites. It appears that roe deer was finding its niche closer to humans and food, whereas red deer more avoided human proximity. Two main predators of deer were selecting sites where they could be in the same time closer to their primary prey and to minimize encountering humans. Wolves seemed to be more tolerant to human proximity compared to lynx.



## Interspecific interactions between large carnivores in Slovenia

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Interspecific interactions are often the key factor affecting structure of animal communities. In Europe, interactions between large carnivores are mostly poorly understood and very little is known about potential anthropogenic influence on these interactions. We studied interactions between three species that occur sympatrically in the northern Dinaric Mountains: grey wolf (*Canis lupus*), Eurasian lynx (*Lynx lynx*), and brown bear (*Ursus arctos*). Diet analyses indicated moderate food niche overlap between Eurasian lynx and grey wolf. We did not notice any indications of exclusion or avoidance between wolves and lynx neither in distribution range, home-range distribution, nor in the space use within the overlapping home-ranges. Data thus indicate relatively low level of competition between grey wolves and Eurasian lynx in this region. Ecological niche of brown bear differ considerably from that of grey wolf and Eurasian lynx. Nevertheless, we observed relatively strong interactions between bears and the two predators via kleptoparasitism. Bears frequently displaced predators from their kills. For lynx we estimated that 15% of all biomass of large prey was lost to bears and in response, lynx increased their kill rate by 23%, thus compensating 59% of the losses. Rate of kleptoparasitism by bears on lynx and wolves varied among seasons and was strongly correlated with bear movement rates. Results are discussed also in the context of effects of human activities on the observed interactions between large carnivores. For example, intensive supplemental feeding of brown bears seems to intensify kleptoparasitic interactions between bear and lynx and wolf, while availability of alternative food through livestock breeding and carrion feeding sites decreases competition between wolf and lynx.



## First results of a telemetry study on wolves in Germany

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After 150 years of absence the wolf is back to Germany. The population is rapidly increasing and spreading. For many people the wolf still represents a symbol of wilderness. However, today's Germany is one of the most crowded places in Europe with 80 million people living here (225 / km<sup>2</sup>) and the country with the highest road density on this continent. Against this background the Federal Agency for Nature Conservation launched a pilot study on dispersal and population spreading of wolves in Germany. In the frame of this project six wolves were fitted with GPS-GSM collars, four pups and two adults. Two of the wolves captured as pups dispersed, but showed very different dispersal patterns even though they were litter mates. One dispersed over a long distance (800 km straight line) when 12 month old. His brother made a 150 km excursion when 10.5 month old, but returned to its natal territory. From there it made shorter excursions in all the adjacent territories until it founded a new pack close to its parent`s territory. The other two wolves that were radio collared as pups stayed in their natal territory even when becoming mature and finally took over the respective territory. Home range size varied greatly not even in regard to different methodology but also between individuals. Kernel analysis revealed that wolves in Germany don't use their territories evenly, but have small core areas where they mostly spend the day and often can even be found during the night. The Kernel made up only 18% of the MCP100 and the MCP95 was about half as large as the MCP100. This applies to breeding individuals as well as to yearlings still living in their natal territory. This first data of wolves in Germany underlined that retreat areas are very important for wolves living in a highly fragmented landscape. Our hypothesis is that in highly fragmented landscapes like Germany where wild ungulates are abundant the availability of retreat areas has a greater effect on the territory size of wolves than prey availability.



## Environmental and intrinsic correlates of stress in free-ranging wolf packs in Yellowstone (USA), Abruzzo (IT) and Mercantour (FR) national parks

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Stress has been studied in a variety of mammals but is still an emerging field of research in free-ranging individuals. Little is known about factors affecting stress in wolves. When confronted with a stressor, glucocorticoids are secreted to help the organism reestablish homeostasis. In carnivores, cortisol is the main glucocorticoid secreted. Sustained elevated levels of cortisol consecutive to exposure to a long-term stressor can have severe deleterious effects on the organism. In our study, we considered eleven wolf packs belonging to three populations: in Italy (Abruzzo, Lazio e Molise National Park), France (Mercantour National Park) and United States (Yellowstone National Park). We investigated explanatory variables that received little attention to date and examined formerly reported correlates. We aimed to (1) identify environmental correlates of stress in free-ranging wolves and (2) investigate the link between stress and biological factors intrinsic to packs and individuals. We analyzed a total of 461 fecal samples collected during two consecutive winters in each national park. Some of the collected samples were attributable to specific individuals. We measured the level of cortisol metabolites (CMs) as an index of stress, using enzyme immunoassays. Our findings show that CMs levels in free-ranging wolves are associated with global as well as local factors. Our results suggest that wolf packs of the Italian national park are exposed to sustained stress. We discuss the potential effect of high wolf density and the presence of a sympatric free-ranging dog population on the CMs levels measured in the Italian packs. Our results also reveal variations that correspond to relatively short-term stressors acting on part of a population only. Thus, exceptional monthly variations in CMs levels reflect particular behavioral or social events. Our results also suggest that stability of a group is an important factor affecting stress level in free-ranging wolf packs, while gender, age and social status of individuals did not correlate with CMs levels in the studied packs. We advocate repeated monitoring of stress in free-ranging wolves and other wildlife to better assess potential harmful sustained stressors. When possible, such stressors should be mitigated or eliminated.



## Making Institutions Fit: Wolf-related Knowledge and Adaptation in SW-Finnish Wolf Politics

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The grey wolf (*Canis lupus*) has been protected for forty years in Finland. When Finland joined the European Union in 1995, the species became strictly protected. The population size started soon to grow and increased gradually until 2006, when the population size exceeded 250 animals. Since then, the population size has decreased, being now some 120 individuals. The current rules that guide the wolf-related human actions are clearly somewhat 'misfit' to the problem, because they do not fulfill their intended purpose, to protect the wolf. We ask how problems of institutional fit affect the local knowledge production practices, i.e. how and with what kind of knowledge the decision-making processes are fuelled with. In this article, based on case study methodology and empirical information collected since the establishment of one wolf territory (2005-) in SW-Finland, we focus on the local epistemic practices and the role of local agents in adapting and attempting to make wolf-related institutions more fit from their perspective.

We recognised various ways how the strict wolf protection policy shapes locally 1) the types of knowledge that are collected and recorded, 2) the tools used to manage the local knowledge, and 3) the networks of exchanging and producing useful knowledge. We discuss the implications of our findings for the policy formulation and organisation of collaboration in LC-monitoring.



## Current on farm protection measures to prevent depredation by wolf – Slovenian case

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Slovenian farmers who breed livestock on pastures in an area of large carnivore permanent or occasional presence use various management practices that may help reduce small ruminant losses to wolf or bear. To get an overview of the range of the methods farmers use to prevent predation a research was done in the framework of Life project SloWolf. A survey was conducted in 2011 whether there are any differences in protection measures between the area with permanent presence (PP) and the occasional presence (OP) of wolf in Slovenia. We also checked if there were more wolf attacks in the PP area and what measures did farmers take to prevent further damage. We asked about the farmers' opinion of government financial support, information accessibility and fence efficiency. We wanted to know whether the farmers are willing to put more effort into prevention methods to protect the flock. Our findings showed that most of the farmers have sheep and goats, which they mainly began to breed in the last 20 years. Most farmers had a conventional mesh, wire and rope fences (PP= 62 %, OP= 56 %), followed by the use of electric wire fences (PP= 48 %, OP= 45 %), then electrical nettings (PP= 22 %, OP= 27 %) and fences built of stone and wood (PP= 2 %, OP= 1 %). The use and characteristics of fence types did not differ between PP and OP areas. Results showed statistical significant differences in the use of dogs and other measures of livestock protection (both visual and audible devices, decoys and other). Night enclosures were not common (PP= 10 %, OP= 4 %). Statistically there were more attacks in the PP area. After the attacks, in most cases the farmers did not improve the security of the livestock; however, they had removed the carcasses. Farmers suggested they need more government financial support in form of subsidies for proactive measures and more information on this topic. We found the interviewers were prepared to move livestock to safety in case of greater probability of attacks (PP= 79 %, OP= 80 %), however, they were not prepared to put so much effort into disassembly the fences after the end of grazing period. Farmers mostly agreed the use of the fences can reduce damage from wolf attacks (PP= 87 %, OP= 89 %). Protective measures are not fully exploited which means there is still place for improvements. Managing predation in Slovenian case requires an integrated approach where good animal husbandry and adapted use of grassland is combined with additional control methods.



## Wolf predation on overwintering livestock in the semi-arid Vashlovani National Park, Georgia

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Nomadic Tushetian pastoralists over-winter their sheep and cattle in the semi-arid grasslands of East Georgia in the central Caucasus where grey wolves (*Canis lupus*) are common. Where human-carnivore conflict is prevalent, conservation measures may be compromised with potential consequences for the area's globally important biological diversity. In 2010 the Georgia Carnivore Conservation Project carried out a study to quantify conflict issues between pastoralists and large carnivores in and around Vashlovani Protected Areas and to identify possible mitigation measures. Livestock owners and herders at 69 farms were interviewed using a semi-structured interview protocol covering details of livestock, farm facilities, husbandry practices and levels of mortality. Predation was reported to be the biggest cause of livestock mortality, followed by disease. Grey wolves, reported as being the main problem species, most often attacked sheep, the most commonly farmed species, but also killed or injured cattle, horses and donkeys. Most livestock losses were experienced in winter, particularly during the lambing season. Three quarters of 105 documented attacks on livestock reportedly occurred in the afternoon or at dusk, normally when the flocks were in pastures. Only 15% of attacks occurred at night, when flocks were usually confined to a corral in the vicinity of farm buildings. Farms had a mean of eight livestock guarding dogs, which were considered an effective means to limit losses. Based on this survey a conflict mitigation toolbox was designed to frame a strategy for management.





## The Wood River Wolf Project: Six years of coexistence work in the heart of Idaho

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Since 2008 the Wood River Valley in central Idaho has been the scene of one of the most comprehensive wolf and livestock coexistence projects in North America. Each year over 25,000 sheep pass through the valley. This valley is also home to black bears, coyotes, cougars and wolves. For the last six years the Wood River Wolf Project has been testing an array of non-lethal strategies to reduce livestock loss to wolves and to protect native wildlife. This multi-partner project brings together local sheep farmers, wildlife biologists, state and federal agencies, conservation NGOs and the county commissioners, in a unique stake-holder driven process that has grown and evolved over the years. Before the project was initiated, sheep and livestock guard dog losses to wolves were a common occurrence, and wolves were killed to reduce losses. Research shows that local killing of wolves may have a short term effect on livestock depredations, but over the long term new wolves rapidly fill in vacant habitat, and if the livestock remains vulnerable to wolf predation, the cycle of depredations and loss continues. After the first five years of the project, documented sheep losses to wolves in the project area were significantly lower than any other area of the state with similar sheep and wolf densities. Specifically, documented sheep losses to wolves in the project area have averaged 0.01 % compared to 0.54 % according to state-wide estimates during the same period. Additionally, no wolves within the project area have been lethally removed because of depredation conflicts.



## The return of wolves to Germany and an example for good practice management

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Germany's large carnivores were already eradicated in the 19th century. Since then the human population nearly quadrupled. Today's Germany is one of the most crowded places in Europe with 80 million people living here (225 / km<sup>2</sup>) and the country with the highest road density on this continent. For sure this country is not what you have in mind when talking about wilderness. And yet Germany harbors not only 17 times more people per square kilometer than Norway (5 million people or 13 / km<sup>2</sup>), Germany also has 7 times more wolves. How comes? The wolf is one of the most adaptive mammal species on earth. As habitat generalists wolves don't care if a landscape is more or less wild. All they need is enough food and the tolerance of people. Of course wolves easily get into conflict with peoples interests. But many of these conflicts, especially wolf – livestock conflicts can be solved. Germany will not become a wilderness country in the near future. But wolves make Germany a little bit wilder. And it looks like a large part of the society welcomes this. Although wolves can live almost everywhere, it's still people deciding where wolves actually are allowed to live. The population increase was and still is rapid, from one wolf pack in 2000 to more than 20 in 2013. For a society living more than 150 years without large carnivores this presents quite a challenge, particularly as Germany is a federalist country where the responsibility for large carnivore management relies on the 16 States (Länder). So far 10 States have regional wolf management plans. The solutions for conflict mitigation are quite divers. Saxony has the longest experience with wolves in Germany and developed a wolf management that is seen as good practice in Germany and could serve as an example for good practice management even beyond boundaries. This management is focused on the three steps monitoring – public relation work – damage prevention, which are all closely interlinked with each other.



## Overview of trends in hunting-induced wolf *Canis lupus* fatalities, in Bulgaria, for the period 2006 - 2009, as a major anthropogenic factor of species mortality, in the context of developing a National Wolf Management Plan

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In Bulgaria, according to Hunting Law, the wolf can be hunted throughout the year, without quotas or other limits. The species is included in Annex II and IV of the Bulgarian Biodiversity Law, in Annex II and V of the Habitat Directive (92/43), and is a target species of 124 Natura 2000 sites within this country. In 2008, a process of developing a Wolf Management Plan in Bulgaria began, with the participation of all major stakeholders: Relevant official institutions, research institutes, and groups and organizations, with the main vision "To increase understanding and commitment to wolves, and create preconditions to ensure their continued existence in Bulgaria, while minimizing wolf-human conflict."

One of the main issues discussed during the development of the plan was defining a period of the year during which wolf-hunting would be prohibited. The proposed period was April – June, a key time for successful propagation of the species. In connection with this proposal, detailed data were collected on seasonal dynamics of wolf hunting in the country.

Data is for the period 2006 - 2009 and was obtained by questionnaire completed by all regions of the Executive Forest Agency (EFA) in the country. It included questions on number of wolves killed, categorised by month, gender, age and location.

Total reported killed wolves for the period 2006 - 2009 is 972 individuals or a mean of 243 individuals per year. Figures for monthly kills were also calculated, showing the yearly dynamic.

An SQL Query was performed on the data for killed wolves where geographic coordinates were available, utilising the WITHIN function of the GIS software package, MapInfo, to determine percentage of wolves which were killed inside Natura 2000 sites, and comparison with the figure for non-Natura 2000 areas, also illustrated on a map.

The main number of wolves (72%), is shot in the period October - January, and 7% in April - June. Generally, more male wolves than females are shot. A significant percentage of wolves were shot within the Natura 2000 sites.



## The role of large carnivores in observed and expected changes of Alpine farming in Bavaria

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In the Objective 2 of the RowAlps project, the question is considered, which role wolves, lynx and bears play in the Bavarian alpine farming system. Ten guideline-based interviews were conducted in three regions with alpine farmers and officials of the Alpine Farmers' Association. The data analysis was done with a qualitative content analysis technique with the main categories "local alpine farming system" and "political system". Changes of the political system are seen as much more relevant than the impact on the local level. Concerning the every-day-work, mainly flock protection, which is perceived as difficult by the farmers, and the fear of losing animals through attacks or crashes because of large carnivores chasing livestock was relevant. A main reason for the major importance of the political level is the farmers' perception of large carnivores being instrumentalized by other interest groups for their own purposes. This belief results in the perception, that large carnivores are being used as a tool to dislodge alpine farmers from the Alps to establish wilderness there. A conflict is shown, in which practical problems are of second importance: It's a conflict about the perceived prevalence in the mountains. Also questions of animal welfare, lacking trust in politics and experts and a lacking option of shooting large carnivores as an "emergency exit" in case of livestock losses or danger are aspects of the discussion about large carnivores and alpine farming. From the farmers' point of view, other interest groups want to take over this supremacy. Compared to other changes that have already happened in the Bavarian alpine farming system and led to an abandonment of mountain pastures especially in the 1950s and 1960s, the major differences to the expected comeback of large carnivores were following:

- the velocity of the change
- the circumstance that it is a question about life or death for livestock
- the economic disadvantages for several interest groups
- the fact, that the question of whether there will be a comeback of large carnivores or not seems to be decided by interest groups in the farmers' eyes
- the interest in the topic by media



## Prevention measures to avoid depredation on livestock in Bavaria

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The immigration of the brown bear JJ1 alias "Bruno" in 2006 triggered the development of management plans for the three large carnivore species lynx, wolf and bear in Bavaria.

Lynx is established in a small and transboundary population in the Bavarian-Bohemian forest. Wolves are irregularly recorded as transients or – in one single case so far - as resident animals. Even a single bear can occasionally reach the Bavarian part of the Alpine arc, stemming from the population in the Adamello Brenta group.

Depending on the population status of the species (transient - single resident individuals - population) the species management plans contain a variety of actions, e.g. the establishment of a monitoring network across Bavaria, systematic use of automatic cameras, public relation work, damage compensation and the implementation of prevention measures.

In order to reduce conflicts between extensive grazing and the presence of large carnivores the Bavarian State Ministry for Environment and Health and the State Ministry of Nutrition, Agriculture and Forestry have opened a special, so called "prevention fund" in 2012 to make known, test and implement different prevention measures. The main contents are (1) giving information and advice to livestock farmers, (2) test and implement prevention measures and, based on these experiences and on existing examples abroad (3) develop a subsidiary system covering effective prevention methods.