



book of abstracts



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Wolf Conservation in Human Dominated Landscapes

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Ljubljana, September 2013

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Table of contents

Oral presentations

Conflict mitigation and resolution	1 - 10
Population monitoring	11 - 16
Wolves and human attitudes	17 - 21
Genetics and molecular ecology	22 - 26
Wolf socio-biology and ecology	27 - 33

Poster presentations

Conflict mitigation and resolution	34 - 42
Population monitoring	43 - 50
Wolves and human attitudes	51 - 53
Genetics and molecular ecology	54 - 57
Wolf socio-biology and ecology	58 - 62



Rewilding Europe with the wolf: can we turn controversy into coexistence?

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The last 40 years have seen some major changes in the status of many species in Europe. Wild ungulate populations have expanded in most areas, and large carnivore populations have increased in their historic strongholds as well as recolonizing (either on their own or through reintroduction) to many areas from which they had long been absent. Parallel with these developments in the status of wildlife species have been changes in both the legislative structures and in the heuristic frameworks within which we view both the means and goals that govern the human relationship with wildlife. In the wake of these changes a number of diverse conflicts have emerged both between humans and wildlife and between diverse stakeholder groups over issues of wildlife management and conservation. The wolf is probably the most controversial, best studied and symbolic animal at the centre of these conflicts. This talk will examine the diversity of ways in which wolf centric conflicts are manifesting across Europe. It will then relate this to the related discourses and controversies around the different conservation heuristics that exist, with special emphasis on the recent emergence of rewilding and wilderness as themes in Europe. Finally, the talk will explore the potential for turning controversy into coexistence.



LIFE Ibrewolf and LIFE Medwolf: two LIFE projects for wolf conservation in central Italy – preliminary results and future activities

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LIFE projects Ibrewolf and MedWolf are being implemented in the Province of Grosseto in Central Italy, and the latter also includes a project area in Portugal. The extension of the project area in Italy is 450.000 ha. The two projects target two main threats to wolf conservation: wolf/dog hybridization and conflicts with human activities in rural areas.

Preliminary information from a survey on wolf-dog hybrids suggest the presence of at least 3 packs in the area, and in each of them at least an individual with phenotypical characteristics of hybrids was detected with camera traps.

The high rate of attacks to domestic livestock in the area suggests that predators include a diverse community of canids that can potentially be involved in attacks to livestock. This has been confirmed by the capture of 8 free ranging dogs, one killed individual with hybrid genes, and one hybrid. The territory of the Province has been re-colonized by wolves in recent times (few decades) and the risk of hybridizations is high, also given to the fact that dogs are often left free-ranging.

Furthermore, the systematic lack of adequate preventive measures, coming from a tradition of extensive free-ranging livestock management, and the presence of a relatively new system for compensation of damages apparently result in a very critical situation that calls for an immediate and integrated intervention. The regional administration has adopted an insurance system for damage compensation, unique case in Italy. According to the current law a total of ca. 1.200.000€ was paid in the period 2007-2012 for damage compensation and prevention measures. However, such system seems not to be appreciated by livestock owners as suggested by the majority of livestock owners not declaring damages suffered. LIFE Ibrewolf aims at increasing the awareness on the impact of hybrids wolf/dog and implements some pilot actions for the removal of such individuals from the local packs, while LIFE MedWolf aims at implementing means for mitigating the existing conflicts through the use of different preventive measures and/or combinations of them. The two projects, implemented in collaboration with representatives of environmental organisations such as WWF Italy and Legambiente, as well as representatives of the livestock owner associations, represent an excellent example of shared responsibilities towards the mitigation of conflicts of interests.



Evaluating management effectiveness: Does wolf management in Croatia support long-term survival of wolf population?

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Evaluation of management effectiveness is a tool used to understand adequacy of existing management practices and indicate possible improvements for future management planning.

In last two decades significant efforts have been invested to maintain viable wolf population in Croatia. Are they sufficient? The protected areas management effectiveness evaluation methodologies were adjusted to evaluate wolf management in Croatia. Assessment was exercised based on assessors' involvement and good insight into wolf problem area, stakeholders' opinions expressed through wolf management planning processes and inputs from relevant experts.

Six elements of management cycle were analyzed: context, management planning, inputs, management processes, outputs and outcomes.

The existing management supports maintenance of wolf population at biologically and socially acceptable levels. This is mostly a result of high motivation and efforts of nature conservationists and scientific community, good level of stakeholders' participation in planning, inflow of substantial EU funds in the past and fair allocation of finances from the State budget (until 2009's financial crisis most of financial needs were fulfilled) as well as existence of standing advisory body to the ministry responsible for nature conservation.

Several issues should be improved, including human capacities for communication with stakeholders at local level, monitoring and law enforcement; funding availability and diversity; capacities for coordination of overall wolf management plans' implementation; participation of particular stakeholders in management planning – such as livestock breeders; and awareness about development of large carnivores' based tourism. Transboundary cooperation should be improved as well, particularly with Bosnia and Herzegovina.

The results of this evaluation are useful to decision-makers providing a clear insight about cost-efficiency of the decisions and warning about possible and potential problems. Stakeholders involved in management process can learn whether their efforts are used sufficiently. On the broader scale, used methodology and results could be beneficial to wolf managers and conservationists at European and global level. Methodology could also be applied for evaluation of effectiveness of management of other species, including those that are less complex to manage.



Foraging ecology, economics and conservation of Arabian Wolf in Asir region of Saudi Arabia

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We determined the food availabilities of the large carnivore in Asir region of western Saudi Arabia using camera traps of more than 1000 nights. The key predators, we photographed including Arabian Wolf *Canis lupus arabs* and several others. The estimating prey availability and by monitoring camera trapped large carnivores shows that the frequency of occurrence of livestock mainly Domestic goats (*Capra aegagrus hircus*) and Domestic sheep (*Ovis aries*) were of most abundant in the whole region where above mentioned carnivores are distributed. Other important wild prey-bases were Rock hyrax (*Procavia capensis jayakari*), Mountain gazelle (*Gazella gazella cora*), Nubian Ibex (*Capra ibex nubiana*), Hamadryas baboon (*Papio hamadryas*) and some areas Donkey (*Equus africanus asinus*) might have been attacked by wolves. The frequency of food items recorded by camera traps of different wolf packs reflected their relative availability that also includes partridges and other birds. For carnivores' distinction between scavenging and predation was only possible through continuous monitoring through camera traps. The average feeding interval obtained from monitoring was 3.6-0.7 (S.E.) days and the average consumption/ wolf /day was 1.8-0.3 (S.E.). Livestock carcasses and killed by wolves contributed that contains sheep and goats formed most (70%) of the biomass consumed by wolves whereas wild animals such as mountain gazelles, hyrax and other 30% respectively. Predation on sheep and goats therefore was much higher and translated in an estimated loss of Saudi Arabian Riyal 1,200 per sheep/goat and on an average the loss of cattle is estimated to be 20-30 animals per village per annum that constitute SAR 30,000. We propose that landscapes such as the Asir with high wolf density, low natural prey availability and consequently high human-wolf conflict levels should be prioritized as prime sites for these two large carnivores' conservation efforts.



Wolf feeding strategies in agricultural landscapes: lessons from two areas in Portugal

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In Portugal, wolves have survived in a profoundly modified landscape which humans and livestock have been shaping since thousands of years ago. Living in a human-dominated landscape has moulded several biological traits of Iberian wolves, such as feeding habits. This study aims to address wolf diet (frequency of occurrence in wolf scats, F.O.), selectiveness towards domestic ungulates (Ivlev's electivity index, E) and kill rates using official statistics of wolf depredations on livestock (n° kills/wolf/year and Kg/wolf/day) in Portugal. Two study areas were selected (Peneda-Gerês and South Douro River), both characterized by an almost depletion of wild ungulates and a high density of several domestic animals under different husbandry systems (extensive grazing vs. intensive production farms). In both study areas, wolves feed on several species of domestic animals (cattle, horses, goats, sheep, pigs, rabbits, birds of poultry and dogs), being ungulates the most important food item (F.O. > 75 %). In Peneda-Gerês, wolves rely mainly on cattle, horses and goats, with a high positive selection for free-ranging horses (E =0.9). Kill rates on domestic ungulates are higher on goats and sheep (up to 25 kills / wolf / year) than in adult cattle and horses (4 kills / wolf / year). In this area food intake by wolves is mainly obtained by predation, which raises a huge economic and social conflict with livestock production. In South Douro River wolves mainly feed on cattle and goats, with a positive selection for cattle (E=0.5). Regional dissimilarities in kill rates on domestic ungulates (> 100 kills to < 1 kill / wolf / year) reflect that in this area wolves rely not only in predation but also in scavenging on livestock products, which are a localized and unpredictable food source. Results show a high dependence of Iberian wolves to anthropogenic food resources, which are exploited through different strategies: predation vs. scavenging. The implications of these feeding strategies will be discussed in relation to wolf biology (e.g. energetic requirements, foraging behaviours) and management actions to achieve a sustainable coexistence between wolf populations and human interests.



Use of electric nettings as night time enclosures to prevent wolf predation on kart pastures in Slovenia

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Electric fencing is a well accepted method of controlling domesticated stock. Electric fence represents almost no physical barrier, but instead relies almost entirely on the fact that the animal gets shocked whenever it touches the fence. In recent years also in Slovenia many livestock farmers, who graze animals in the area of permanent or occasional presence of wolf found electric fencing (permanent or temporary) a highly efficient and low cost method to stop the conflicts between this carnivore and their property. In the framework of LIFE project SloWolf we tested in South Western part of Slovenia a novel approach in minimizing damage on pastures on small ruminants due to wolf predation. We donated 5 prevention measure sets in 2011 and 3 sets in 2012 to farmers who raised from 70 to 250 sheep and had wolf attacks in the past. A prevention measure set consisted of 5 high (170 cm) electric nettings, battery energizer (1,5 J), four galvanized earth stakes, battery energizer box and digital volt meter. With such sets farmers set up night time enclosures on pastures to gather sheep to stay inside over the night or their livestock if a flock was of small size stayed all day behind the nettings. It was important that during the night all animals were kept inside the enclosure, no gaps were present under the nettings and nettings needed to be erected. We made regular visits or called farmers to get returned information if attacks appeared. After the commencement of using night time enclosures on pastures, no wolf attacks appeared on those flocks and no damage was compensated. The visibility and the design of night time enclosure, the high power in electric nettings, shifts of enclosures during the grazing season, and proper grounding of energizer are rules that have to be obeyed to make effective electric netting for the need of wolf damage prevention. Large carnivore can survive in the long term on freedom throughout natural habitats of Europe only if they get enough strong fear to people and their property as livestock is.



A new way of protecting livestock against wolves' attacks

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Two types of tools have been used to protect flocks from predation: disruptive-stimulus tools (i.e. disrupt the predatory behavior) and aversive-stimulus tools (i.e. modify the predator behavior). However, none of them modify permanently predator behavior and prevent them from attacking and from coming back to predate on the flock.

The aim of the present project is to create a new tool for livestock protection against wolves that will at the same time protect sheep and permanently modify the predator behaviour toward the equipped flocks.

We will consider the feasibility and effectiveness of three interconnected working hypotheses:

1. Wolves alarm semiochemical (WAS) release is supposed to provoke an instinctive response of flight without passing through any learning process. WAS will be sampled and analyzed. We will study wolves' behavioural response elicited by the semiochemical in order to assess its effectiveness as a protective tool for livestock.

2. Wolf presence or attack triggers in sheep stress or fear that is measurable through heart rate variability (HRV). Sheep will be equipped with a special belt to permanently measure HRV. When the system will detect a sudden fear or stress, it will trigger an alarm to warn the shepherd and a frightening stimulus for the wolf.

3. The frightening stimulus can be associated with a conditioned stimulus that will be then permanently placed on the flock to provoke a conditioned avoidance response.

Wolves will lastingly learn to avoid approaching the protected flocks and through social learning this behaviour will be transmitted to other wolves in the pack.

We expect this new device to become an effective way of protecting livestock where LGD cannot be successfully used.



Development of new methods to protect sheep against wolf attacks

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The usual measures of livestock protection against wolf attacks are night enclosures, electric fences and guarding dogs. We compared characteristics of Slovene sheep farms which experienced wolf attacks with characteristics of those farms that did not have wolf attacks in the pasture seasons 2008-2010 (Van Liere 2013). Electric fences and guarding dogs did not prove effective: they did not prevent wolf attacks or reduce killing rates. Night enclosure, together with moving the sheep there before dusk, proved to be an effective measure, however, not all attacks happen during the night (in our study 78 % of 288 were night attacks). Furthermore, some studies reported that a shift from night to day attacks can happen. One of the alternative strategies we suggest is to apply new sensor technology and automation to one or two animals in the flock with the aim to detect and immediately deter an approaching big predator. Approach of a big predator causes acute stress in livestock, which sensors can monitor. The principle is already tested by Swiss researchers, using increased heartbeat, but in a different context. Beside increased heartbeat we would consider sudden drop of the ear's temperature as a second stress indicator and a combination of both. Moreover, robust sensors contacting the skin would measure these sudden anxiety-induced changes and subsequently transmit this to a small logic board at the fence, which would then immediately activate deterrents as big lights (in case of night attacks) and sounds of gun shots. This would induce operant learning where the wolf links his approach to sheep with unpredictable negative events. The immediate response to a wolf's approach would prevent reinforcement of chasing, killing and consuming livestock and thus prevent wolves to appreciate livestock as an 'easy pick'.



Wolf damages in Slovenia

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Sheep grazing is common land use in wolf range in Slovenia. The sheep are usually not properly protected against wolf attacks and consequently that results in frequent conflicts among wolves and humans. Regular damages result also in negative media reports. Additionally, frequent depredations can result in calls for higher culling quotas and even illegal killings of wolves. Therefore good understanding of circumstances, in which damages occur, is crucial for damage prevention in human dominated landscape in Slovenia. Only good understanding of this problem can result in proper and effective prevention of wolf attacks.

In Slovenia we annually recorded in the last 5 years around 400 damage cases, 300.000 EUR paid compensations in region with approximately 31 – 41 wolves. However, little is known about the circumstances when damage cases occur. For this reason we analyzed registered damage cases in Slovenia since 2007 till 2012. In addition, we documented installed protection measures in the field within core area of wolf presence in Slovenia and filmed the use of installed protection measures.

We will present GIS analysis of effects of different spatial parameters on occurrence of damages, such as: distance from pasture to human settlements, distance to forests edges, size of forest complex, size of sheep herd and biomass of natural prey. In addition, we will present a comparison of breeders with frequent damages and those with little or no damages, obstacles in damage prevention and possible solutions.



Marginal livestock practices favour coexistence: An example with wolves and free-ranging horse husbandry

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Wolves preying on livestock fall into a permanent conflict with humans. However, predation seems to be tolerated differently across livestock practices. Although traditional prevention methods are the most effective tools used to mitigate wolf-livestock conflicts, marginal extensive livestock practices –on the verge of economic viability– can play an overlooked role attenuating conflicts and favouring coexistence. We illustrate it using wolves and free-ranging mountain ponies husbandry in Galicia (NW Iberia), a traditional livestock system providing important ecological and socioeconomic services, which has persisted because it entails negligible costs for farmers. Mountain ponies make a significant contribution supporting wolves in an area with low abundance of wild ungulates (26 out of 33 packs occur where wild ungulates are absent or their density is low) with ponies appearing in at least half of wolf faecal samples collected in eleven wolf territories (range 51%-92%, 70% of the samples overall, n=673). Wolf predation upon ponies does not threaten farmer's economies and seems to be tolerated better than attacks to more valuable stock (cattle). Assuming that the number of hunting permits (hunting requires administrative permission and is used to manage the conflict) reflect the claims of farmers, the low rate of legal control between 2004 and 2007 (three wolves) would suggest a remarkable tolerance of wolves by farmers. However, despite a number of policies promoting the persistence of mountain ponies, recently European Union's regulations on animal welfare or meat production put new economic and administrative burdens on farmers, make free-ranging horse rearing economically unsustainable, and incentivise its abandonment. Among the potential consequences of the decline of this extensive livestock practice, we highlight the rise of a currently attenuated conflict with farmers due to an expected increase in the rates of predation on valuable livestock (cattle). To ensure the long-term persistence of mountain ponies we encourage authorities to implement profitable incentives based on the environmental and socio-economic services they provided, and to assume the ownership and legal responsibility on ponies in key mountain areas of Galicia for biodiversity conservation.



Wolf re-colonization, distribution and population trend in three countries of northern Europe: results from 15 years of joint cross-border monitoring

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During the 1960's, the historical wolf population became functionally extinct on the Scandinavian Peninsula, i.e. Sweden and Norway. However, during the next two decades, a new population was founded in south-central Scandinavia by long range dispersers from the large Finnish-Russian wolf population. During a 35-year-period of re-colonization and reproduction (1978-2013), a Scandinavian increase from less than ten individuals to more than 300 wolves was confirmed by continuous and highly cooperative Swedish-Norwegian monitoring of this joint, cross-border population. In 1998, this international monitoring was extended to a long-term ecological study and cooperation between three Fennoscandian countries in the northwestern-most part of the European wolf distribution range, i.e. Finland, Sweden, and Norway. This North-European, cross-border wolf monitoring has worked well in close cooperation for 15 years (1998-2013), and is still continuing. All three countries monitor wolves by similar and comparable methods, e.g. ground-tracking on snow, genetic analyzes, GPS-based radio-telemetry, and hunter surveys. For each of these 15 years, results and conclusions on Fennoscandian and national population status, distribution and trend are available in official annual printed reports. However, so far these annual monitoring data has not been analyzed and summarized for the 15-year-period in total. The first results from such analyzes will be presented at the conference together with the latest update on wolf population status in the three Fennoscandian countries, respectively.



The wolf population in the Alps: past, present, and the future?

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The wolf recolonized part of its former habitat in the South-Western Alps through dispersal from the Apennines beginning in the late 1990s, after being extirpated throughout the Alps during the 20th century. Current wolf distribution, constructed by the Wolf Alpine Group (WAG), consists of settled wolf packs mainly present in the Western Alps of Italy and France. In the rest of the Alps, dispersers might be detected occasionally, and few settled solitary individuals are detected in the Central-Eastern Alps. The area occupied by wolves in the Alps is connected in the south-west to the Apennines wolf population, the main source for the current wolf recolonization. Recently, an interesting slight connection has been documented with the Dinaric population from Slovenia, and the first reproducing wolf couple composed by one wolf from each population has been documented in Veneto Region. In the future the connection between the Italian population, Dinaric population, and Carpatian population is a probable event of extreme interest that might be documented over the Alps. The spatially explicit, individual-based model (SE-IBM) produced by Marucco and McIntire (2010) allowed an analysis of part of this complex spatial and temporal wolf recolonization of the Alps, providing predictions on the development of new settled packs, and considerations on the future connectivity within the cited meta-population.



Tracking wolves in Slovakia by sign survey and non-invasive DNA sampling

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The grey wolf (*Canis lupus*) in Slovakia is both game and a protected species. Species listed in European Union legislation must be maintained at 'favorable status'. However, there is no management plan for the wolf and no robust system for monitoring the population at the national level. Estimates of abundance vary between the hunting community and environmental NGOs by an order of magnitude. The annual harvest of 120–150 wolves has been the subject of official complaints from within Slovakia as well as from neighboring countries sharing the same population. In 2010 the Slovak Wildlife Society launched White Wilderness: Carpathian Wolf Watch. This volunteer program aims to bring together researchers, nature conservationists and hunters in order to produce more reliable estimates of wolf population parameters which are accepted by all key interest groups. Citizen scientists are recruited locally and internationally. New volunteers undergo two days of training in field techniques including sign recognition. Volunteers are subsequently assigned to groups of 2–4 and survey fixed transects for signs of target species. Positions are recorded using GPS; field signs are photographed to allow verification and samples of urine, feces, hair and blood are collected for genetic analysis. When possible, tracks are followed the next day to map movements and collect additional samples. Camera traps are installed at kill sites and on travel routes. During a 3-week period in January–February, volunteers usually survey a total of c.450 km. Out of 55 samples collected in 2010 and considered by the project team to have originated from wolves, the Molecular Zoology department of Munich Technical University obtained genotypes from 48 (87%). Fifteen different individuals were identified in the about 2,000 km² of study area.



Wolf monitoring without snow – an example from Germany

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After 150 years of absence the wolf is back to Germany. The population is rapidly increasing and spreading. Of course the wolf monitoring should keep track with this population development. However, wolf monitoring in Germany faces several challenges. First, snow conditions are uncertain making a monitoring primarily based on snow tracking impossible. Second, Germany is a federalist country consisting of 16 States (Länder). Although large carnivores are listed by the federal nature conservation act as strictly protected the enforcement, hence the monitoring, relies on the States. So far there is no coordination in regard to wolf monitoring between the States. Third, Germany is sharing its wolf population with Poland therefore data evaluation should be comparable between both countries. During the last years we developed a combination of survey methods that are not snow depended. These survey methods have proofed to be applicable for population size and area of occurrence estimates for the current population status. This combination of methods also appears to be feasible with a further population increase in the next years. The monitoring fragmentation within the country made the standardization of data interpretation absolutely essential. In consequence national monitoring standards for LCs in Germany were developed and accepted in 2009 and revised in 2013. These standards strongly rely on the so called SCALP criteria thus categorizing data according to their verifiability. For population size and area of occurrence estimates only C1 (hard facts) and C2 (confirmed observations) are used. Furthermore we developed criteria to distinguish between adjacent territories – a task that becomes more and more difficult in areas saturated with wolves. Joint monitoring standards between Poland and Germany for the shared population are currently under development. So far Polish and German wolf experts agreed on common definitions, sampling units and sampling periods. However, joint data interpretation will still be a challenge in the next years since both countries still defer in regard to whether monitoring data should be classified according to their verifiability or according to their reliability. However, the first step toward a comparable data evaluation is done.



Wolf pack rendezvous site selection in Greece is mainly affected by anthropogenic landscape features

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In wolves, most offspring mortality occurs within the first 6-8 months of their life. As wolf pups pass this entire period at either the den or rendezvous sites, their selection by wolf packs may affect pup survival and recruitment. Rendezvous sites are important for pup survival as they are used during summer and early autumn, when intense human activity may increase pup mortality. This study describes factors related to rendezvous site selection in order to enhance their protection and management. We studied the rendezvous site selection of 30 wolf packs in central and northern Greece between 1998 and 2010, after locating 35 sites using the simulated howling survey method with the aid of satellite and radio wolf telemetry. We considered 41 environmental and anthropogenic predictors of wolf rendezvous site selection at two spatial scales. At the landscape-population scale, wolves selected rendezvous sites below 1200 m.a.s.l. ($w_i = 0.20$), with large inter-site distance (mean 12.9 km), and avoided partially forested or open habitats ($w_i = 0.52-0.79$), indicating preference for forest covered and spaced areas. Wolves established rendezvous sites in a way to minimize intra-specific competition and maximize access to stable resource availability.

At the home range scale, wolves selected rendezvous sites away from forest roads ($R = 0.232$) and villages ($R = 0.152$), close to water sources ($R = -0.209$), and in areas with low forest fragmentation ($R = 0.172$). Avoidance of human presence and disturbance accounted more than factors related to habitat types or availability of prey. This strategy, adopted by wolves in Greece, may be a response to the long history of human persecution. In the summer of 2011, we tested the ensuing resource selection model (RSF, $AUC = 0.818$) after successfully locate seven new rendezvous sites outside our previous survey area, verifying the utility of prediction maps. All new sites had their center at areas with 0.8-1 model probability. Rendezvous prediction maps can be used to reduce field effort when monitoring wolf populations, assess livestock predation risk, design protected areas, and reduce human disturbance on reproductive wolf packs.



A study on general health status and potential disease risks in grey wolf (*Canis lupus*) of Slovenia

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In order to investigate general health status and the potential disease risks in Slovenian wolf population, 19 female and 16 male carcasses and internal organs were investigated. A detailed necropsy was performed and tissue samples for pathohistological, parasitological, microbiological and radiological investigations were collected. The majority of examined animals (n=31) were culled as a part of regular annual harvest. Three animals died of a massive internal *haemorrhage* as a consequence of collision with vehicles. One pup was found dead due to the interruption of the spinal cord induced by other carnivores. In one female the cause of death could not be determined reliably. Although study revealed good health status of wolves in four animals severe pathological condition of skin was confirmed namely sarcoptic mange and pyodermitis. With the parasitological examination nine common wolf parasite species, including zoonotic *Trichinella* spp. were confirmed. All wolves were negative for the presence of rabies virus and one was positive for the presence of parvovirus antigen.



Local attitudes toward wolves: a case study in Abruzzo, Lazio and Molise National Park (Italy)

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We conducted personal structured interviews (n=1611) to assess perceptions of wolves (*Canis lupus*) among residents living in the different regional portions comprised within the Abruzzo, Lazio and Molise national park (PNALM) and its external buffer area (Italy). Furthermore, the PNALM portion comprising the Abruzzo region was divided into two geographically distinct study zones, Abruzzo Marsica (AM) and Abruzzo Fucino (AF), to reflect their different history as well as cultural and socio-economic settings. Principal components analysis (PCA) was carried out on the interview results, and it suggested 3 main components (general attitudes, wolves' impact on game species, and wolves' management options) that explained 69% of the variance. Based on these results, we developed models to identify the variables that most differentiated the regions. Step-wise logistic regression was performed using region as the dependent variable, and using the saved component scores of the PCA, questions regarding respondents' perceived damages from wolves and respondents' experience with wolves as predictors (model fit: $\chi^2 = 396$, df=27, p).



Changing attitudes to wolves in a transhumant pastoralist community in Georgia

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Efforts to conserve biodiversity can be compromised where human–carnivore conflict is prevalent. The Georgian Carnivore Conservation Project (GCCP) studied carnivore–livestock conflicts in a semi-arid landscape in East Georgia. This included a written questionnaire survey to investigate public perceptions, attitudes and knowledge of large carnivores and their management among 10 target groups. The survey was conducted in 2010 (n = 784 respondents) and repeated in 2012 (n = 1,030). During the intervening period, the GCCP implemented a suite of conflict mitigation and awareness raising measures. Attitudes were consistently more negative towards wolves than towards bears across all target groups and in both surveys, with livestock owners and hired herders holding the most negative views. A large majority of most target groups was afraid of wolves. The baseline survey showed that more knowledge tends to equate with less fear, which in turn correlates with more positive attitudes to predators. Knowledge increased from a mean score of 4.37 (median 4) in 2010 to 4.58 (median 5) in 2012. Whereas 69% of rural residents in the baseline survey considered it bad or very bad that there were wolves in Georgia, in 2012 the proportion holding such views was 53%. The percentage of school pupils who thought it was good or very good that there were wolves in Georgia increased from 30% to 40%. The views of livestock owners on whether wolves belong in Georgia also appeared to mellow: whereas in 2010, 16 of them (22%) answered that they ‘strongly disagree’ and two (3%) answered ‘disagree’ with this assertion, in 2012 only four of them (7%) answered ‘strongly disagree’ while 13 (23%) indicated the milder level of disagreement.



The role of public involvement in wolf conservation and management. Evaluating the effectiveness of public participation in the SloWolf project

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In wildlife conservation and management the need for public involvement is widely recognized. Public participation in environmental decision-making is a democratic right from a normative perspective and is believed to deliver higher quality decisions from the pragmatic perspective. Citizen science programs aim to improve knowledge and awareness of environmental issues. Local involvement in carnivore management is attended to raise the acceptance of carnivores. However, not every public involvement process is effective and evaluation that would identify recommendations for improvement lags behind the practice.

In the SloWolf project, the public and interest groups were involved in several activities that aim to mitigate conflicts related to wolves, raise their awareness and include them directly in wolf management. These activities engaged participants on different levels of involvement.

We carried out 19 semi-structured interviews with a range of participants that were involved in different actions in a wolf conservation project to explore what constitutes a good public participation process and how can it enhance the coexistence of wolves and humans in Slovenia. For the basis of the evaluation of the process, Reed's (2008) criteria were used. All participants agree on the importance of the criteria that we recommend as a basis for future evaluation. As outcomes and process influence each other in participation, we found positive evidence for improved coexistence between wolves and humans through increased social capital through different types of learning.



Human dimensions of wolf-dog hybrids in the Province of Grosseto (Italy)

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Hybridization poses a threat to wolf conservation in areas where small wolf populations coexist with high numbers of feral dogs. In Italy genetic testing has ascertained the presence of hybrids throughout the wolf range, including the Province of Grosseto in central Italy. In 2011 the provincial administration of Grosseto, together with other partners, initiated the LIFE project “Ibriwolf”, aimed at developing techniques to identify hybrids and limit their presence. Considering the social implications of managing such an issue, we conducted a research study to investigate stakeholder knowledge and attitudes toward wolves, feral dogs and hybrids. Questionnaire interviews were carried out in 17 municipalities of the province, where wolf damages have been recorded. A total of 744 interviews were obtained from local residents (n=400), hunters (n=71), livestock owners (n=97) and high-school students (n=176). Results were analyzed by constructing linear regression models to predict attitudes toward wolves and hybrids using knowledge, experience and stakeholder group membership as explanatory variables.

Our findings indicate that wolf presence is primarily a concern for livestock owners and hunters, who consider them a threat to their activities and favour controlling the wolf population. In comparison, attitudes are more positive among local residents and students. Although knowledge regarding wolf biology is correlated with more positive attitudes, beliefs that wolves have been reintroduced are widespread and denote a general lack of communication and trust toward wildlife managers in the area. Knowledge regarding hybridization is also limited: the majority of respondents had never heard of hybrids, did not know they are present in the territory and were not aware of the risks they pose for wolf conservation. As a result, attitudes toward hybrids are confused and divided among students and residents. Our findings suggest the need to conduct information campaigns to increase awareness of wolf conservation as well as responsible dog ownership among the wider public. Moreover, they highlight the importance of developing communication strategies that ensure the information is accepted by those who receive it, and that promote trust and cooperation between wildlife managers and those most affected by wolf presence.



Approaching a general social consensus – a national wolf management plan as framework in a federal country

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Successful wolf conservation requires large scale approaches due to the spatial behaviour of wolves. There is a consensus that populations should be managed across administrative borders. Austria, especially the Austrian Alps, provides large suitable areas for wolves and could be a core area for a future population comprising the entire Alps.

Austria is a federal country with seven states in the Alpine part. Each of them conducts nature conservation and game management on its own responsibility within the limits of the EU habitats directive. In order to reach common approaches among the states a national document on wolf management and conservation has been prepared. This was done in a participative approach with all relevant stakeholders involved in sometimes exhaustive discussions. The final document contains compromises between all stakeholders and has been agreed in the meetings, but not every part of this document will be supported in the public by each of the interest groups. Despite the disadvantage of having a final, but imperfect version, this document can be seen as a basis for future discussions in more detail. Next steps as explicit management plans on the state level and continuous round tables for land owners, hunters and farmers are discussed.



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 ± 2.44 SD; minimum home range = 74.34 ± 51.69 km²; average number of pups/pack = 2.36 ± 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 (*β -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 km² 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/km²) to the other two regions (Kočevsko 2.79 ungulates/km² and Notranjska 2.34 ungulates/km²), but with lower red deer density (harvest: 0.21 red deer/km² versus 1.22 red deer/km² and 0.77 red deer/km²). 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/km²). 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/km² vs. 22.8/km²). Lynx stayed on significantly higher elevations (952 m vs. 791 m), with lower human density (0.00/km²), 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 / km²) 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 / km²) 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 / km²), 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.



Factors affecting depredation levels caused by wolves in livestock farms in Mt. Oiti National Park - Central Greece.

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We studied wolf-livestock conflicts in Oiti National park (250 km², altitudinal range: 600-2200m) during summer of 2012. Livestock farming is consisted by transhumance free-raising flocks grazing from May to late October. Wolf (92/43 habitats directive- annexes II, IV) has shown a remarkable recovery during the last 15 years. 6733 sheep, 2068 goat, 472 cattle and 165 calves graze inside the park.

We interviewed 36 out of 39 livestock units grazing inside the park, using a detailed standardized questionnaire to collect information considering: type of farming, livestock number per species/unit, number and origin of livestock guarding dogs, number of workers involved in livestock guarding, use of predator-proof fences, number of depredation events per year (2010-2012), animal losses/event, and levels of compensation paid per farmer/year. We checked validity of information considering depredation levels, when possible, by comparing field data with that from archives provided by the national agricultural insurance authorities. All interviews were contacted in livestock husbandry areas, as to directly evaluate morphology and behavior of livestock guarding dogs. We compared depredation levels/farmer using non-parametric univariate tests and multivariate analysis (GLM models). Wolf current presence and distribution was evaluated with a network of camera traps been active for 40 days.

Livestock units experienced 2.62 attacks (range 0-20) and 5.4 animal losses (range 0-40) in average per year. Animal losses/attack averaged 2.93 (range 1-18). 12% of units experienced losses >5% of the flock/year. Cattle farms that enforced separation of nurturing calves inside carnivore-proof fences showed a remarkable decrease of depredation events on calves. Goats were selected more by wolves compared to their availability. Levels of losses per livestock unit/per year were negatively related to the number of good quality guarding dogs, number of workers involved in attending the flock, while it was positively related to forest cover of each unit grazing area. Average compensation coverage/year was very low compared to actual losses claimed but it was higher for units enforcing more intensively preventive methods.

Livestock farmers responded rapidly to wolf recovery establishing preventive methods to reduce losses, but with a great expense on labor and maintenance costs resulting in increased social tension.



Understanding factor affecting wolf occurrence in the Western Carpathians

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The conservation and management of wolves in the periphery of their distribution is challenging. Edges of species distribution are characterized by very few occurrences of individuals, which makes difficult obtaining an understanding of population dynamic. The importance of this understanding becomes stronger when hunting takes place nearby the edge, which may preclude population expansion.

Our study focused on the Beskydy Mountains located at the Czech-Slovak border which is at the edge of the Grey wolf (*Canis lupus*) and Eurasian lynx (*Lynx lynx*) occurrences in the West Carpathians. Because wolves are legally hunted in Slovakia and lynx is instead strictly protected year-round in both countries, we were interested in differences of occurrence between these carnivores in the last 10 years.

During 2003-2012, we monitored large carnivore occurrence by snow-tracking surveys. Data analysis revealed a statistically significant difference between the observation of tracks and other signs of wolves and lynx. The wolf was a very rare species and was recorded almost six times less often than the lynx. We discuss whether this pattern may result from differences in life histories between species or differences in management.



Austria – meeting place of three wolf populations: melting pot or black hole?

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The autochthonous wolf population of Austria was extirpated in the 19th century. Today Austria is surrounded by three large (Slovakia) or increasing (Western Alps and Slovenia) wolf populations. During the last 20 years the number of single dispersing wolves showing up in Austria has increased. In the years 2009 – 2012 at least 11 individual wolves were detected by genetic monitoring. These wolves were found almost all over Austria independent of the population they were originating from. Wolves from the Western Alps were found from Tyrol to Lower Austria, wolves from the Carpathian and the Dinaric Mountains reached areas far north and west in Austria. As a meeting point Austria may develop into a cross-breeding area of wolves from three distinct populations.

According to the time single dispersing wolves did stay in Austria, there seems to be a high turnover. Most wolves were detected only once or a few times within one year before disappearing again. One wolf has settled for about two years in Lower Austria but may have disappeared recently, too. The fate of most of the wolves is not known. Illegal killing may be a relevant cause regarding the fact that even competent state ministers concluded publicly that wolves and bears should be better shot due to the many troubles they cause. In this paper we discuss the reasons for the observed high turnover of wolves in Austria as well as the obstacles to ensure law enforcement and achieve acceptance of wolves.



Ascertainment of the spontaneous return of the wolf in Lessinia (Venetian Alps, Italy) and of the formation of the first mixed couple Italic-Dinaric

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The wolf in the Italian Alps has disappeared at the beginning of the last century due to persecution by man. In Veneto the latest reports date back to 1931 (Belluno area), in Lessinia (Province of Verona, N45°41'00 "E11°02'00") the extinction of the population dates from the first half of the 19th century, with possible isolated attendance until 1880. In January, 2012, after more than 130 years by the latest reports, it has been for the first time ascertained the wolf in Lessinia, as a result of a spontaneous phenomenon of dispersion.

The non-invasive monitoring and radio-tracking, performed in 2012 by staff of the Regional Natural Park of Lessinia, the State Forestry Department and the Provincial Police of Verona, have allowed to ascertain the presence of three wolves and the constitution of a couple formed by a female of Italic origin and a Dinaric male. The third one, a female found dead in August 2012, she was also belonging to the Italian population.

The Dinaric male "Slavc", equipped with a GPS radio-collar within the Project Life+ "SloWolf", has undertaken the dispersion phase on December 2011 and took office in Lessinia in March 2012. The Italian female, "Juliet", whose membership of the Italic population of wolves was genetically determined, comes in with all probability from the Italian western Alps and she has been detected in Lessinia from the beginning of 2012.

Their meeting, photographically and genetically documented since April 2012, gave rise to a potentially reproductive couple, which is, at the actual state of knowledge, not only the unique one in the north-east Italian Alps but also the absolute first one consisting of two wolves coming from different population, the Italic and the Dinaric one, not in contact each other for many centuries, event of exceptional biological and conservation value.



Monitoring of wolves by volunteers in Slovenia

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Continuous monitoring of population size and distribution is crucial for conservation and effective management of any species, but is often difficult to maintain, especially for elusive species like the grey wolf. Large areas are difficult and expensive to monitor. Collaboration with interested and trained volunteers is sometimes used to improve coverage of study area. However, data collected should be interpreted with caution and regular training of volunteers is highly recommended. In Slovenia wolf population was monitored between 2010 and 2013 using a sign and vocal survey conducted by volunteers and professional biologists. Sampling approach was designed to collect data and 2429 volunteers were included in wolf surveillance activities. 732 volunteers attended educational seminars, 453 took part in winter snow tracking and 190 in summer wolf howling monitoring. With participation of large numbers of trained volunteers, it was possible to monitor an area up to 3384 km² in one day. In winter minimum of 171 km of wolf tracks were followed, 12 prey remains and 185 genetic samples were found, importantly contributing to results of genetic analyses. Together with data collected by researchers and Slovenian Forest Service, the estimation of wolf population size, number of packs, distribution, and effective population size was done.



Evaluation of different method for monitoring wolf pack in the Appennine environment

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The wolf is one of the most difficult terrestrial mammal species to survey. That is due both to biological and habitat aspects. Wolves live in low density and have a secretive and predominant nocturnal life style. Moreover in many European Counties wolf presence is concentrated in remote areas, mainly mountainous and forested areas, with low human presence and scarce practicability of road network.

The wolf's presence goes often in conflict with human activities, as livestock and hunting. So province administrations, and research institutes needs to obtain census data with high accuracy.

The study was carried out in the North Apennine of Tuscany Region, Italy from April 2012 to March 2013. The methods performed in this study were: snow-tracking, wolf-howling, and camera trapping. We evaluated the wolf pack size and specie detectability between different methods.

Our study showed that there wasn't a significant difference between methods to evaluate the wolf pack size. Snow-tracking was the best method to discovery quickly the wolf presence than others ones. Wolf-howling and camera trapping permitted to evaluate breeding success of wolf pack. Moreover, camera trapping permitted to collect the highest number of wolves in the pack.

We conclude that to evaluate pack size and breeding success it's fundamental to perform all methods overlapping the information deriving from different methods.



Anticipating future human-wolf conflicts: predicting wolf expansion areas in Portugal

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The original range of the Portuguese wolf population decreased drastically until the late 80's. The wolf is fully protected in Portugal since 1986 and at the end of the nineties the population stabilized until current years. With recent wolf recovery in south Douro River in Spain, we can predict an expansion toward Portuguese territories. Since 80% of wolf diet in Portugal is livestock, the conflict with humans is expected to be high in recolonized areas. The aim of our study was to investigate possible wolf expansion areas and identify conflict zones to develop prevention actions. We developed a Habitat Suitability Index using Maxent model and reliable wolf presence data, from camera trapping and scat surveys with genetic validation. Using Maxent regularization multiplier of 1 and 10% omission rate, the resulting model corresponded to 9.5% of Portuguese territory mostly in the known wolf range. Since wolf is a generalist species we then changed threshold values for Maxent regularization parameter and threshold values for model training omission rate to highlight other possible expansion areas, under current conditions. New areas were mostly constituted by border zones with Spain, from Douro river to south of Tagus river, never reaching coastal areas, adding up around 5% more national territory than initial model. Besides wolf monitoring, prevention actions in these areas should include aid to livestock owners to implement livestock protection methods (e.g. guardian dogs or fences) and general public awareness.



Documented long-distance dispersal of wolf (*Canis lupus*) from Dinaric population with successful pack formation

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Dispersal is natural process in a wolf lifetime, when natal pack is left in search of mate, new territory, and food resource. Dispersal has major influence on distribution and genetic structure of animal populations, but is often difficult to detect. In winter 2011/2012 we documented a long dispersal of 2-year old male grey wolf (*Canis lupus*) "Slavc" from Dinaric population to the Venetian Alps. Wolf was equipped with GPS-GSM-VHF collar on 17th July 2011 in Slovenia. He left his transboundary Slovene-Croatian natal pack on 19th December 2011 and after 100 days of dispersal and crossing of three countries became stationary in the Lessinia Regional Park in Italy. He formed a new pack with female wolf that dispersed from the Italian peninsula population and the pair successfully mated in 2013. His new home range (100% MCP) size was estimated to 150 km² in comparison with 442 km² home range size (100% MCP) of his natal pack in Slovenia and Croatia. 2445 successful GPS locations were obtained from his collar and the total consecutive straight line distance between locations that male travelled during his dispersal was 1176km, overcoming anthropogenic and natural barriers such as highways, railways, urbanized and cultivated areas, river dams, large rivers and mountain ridges in Slovenia, Austria and Italy. From the present distribution in Dinaric wolf population, this is the first documented case of long dispersal with successful pack formation from two distinct wolf populations, showing a potential for future joining of these populations.



Shortcomings in assessing the status and planning the management of wolf population in Romania

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Wolf population dynamics is extremely different across Europe. Due to negative attitudes toward the species, intense harvesting, poaching, and economical and political aspects, wolves range from extinct in the North-Western and Central parts of the continent to large populations in the Eastern countries. In the last fifty years, wolf population dynamics in Romania was unstable. Between 1960 and 1970 the wolf numbers dropped from more than 3000 to about 1500. After 1970, laws for preserving large wild ungulate species led to a continuous ascending trend in wolf population. Field forms and the summarized data provided by the Hunting Funds managers in Romania, from 2005 to 2012, were analyzed and compared to the final official estimates of wolf population data, modeled by The Forest Research and Management Planning Institute (ICAS). During this period, the official estimates show an effective of 2300 up to 2700 wolves. The largest number of wolves is reported in the Carpathian Mountains, covered mostly with dense forests and many remote areas, difficult to survey during winter. Due to some methodological inconsistencies, census actions are not sensitive to the probabilities of double counts – as wolf packs home ranges are larger than Hunting Funds surfaces – and the data shows a high degree of uncertainty. Moreover, nationwide, snow tracking is the only method used to estimate and monitor wolf population, and these data supplies the final official estimates and the hunting regulations. Based on the official estimates, the Romanian Carpathians are still home range of a healthy, viable wolf population, and this offers a great opportunity for wolf conservation in a natural environment. Nevertheless, the limited reliability of the data, together with continuous habitat loss, makes it difficult to reach the conservation objectives. A successful implementation of management and conservation programs requires integrated monitoring and assessment of the ecological status, and trends in the dynamics and distribution of wolf populations. Further research is necessary to improve the data quality, among which testing of the applicability of other survey methods for effective monitoring of wolf population is crucial for scientific substantiation of management measures.



Attitudes toward, conflicts with, and management of wolves in rural villages in Armenia

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As is the case in other regions of the world where wolves and humans interact, human-wolf interactions in Armenia often result in feelings of animosity and helplessness, dead livestock and dead wolves. The Armenian government annually endorses a wolf cull however the size of wolf populations in Armenia has never been quantified nor has the actual extent of human-wolf conflicts in Armenia been studied, until recently.

During the summer of July 2012, I surveyed 23 communities in 4 regions of Armenia about their experiences with human-carnivore conflict. Using a combination of open-ended interviews, focus groups, community mapping and risk-ranking, I created a baseline for human-carnivore conflicts in the country. Among the topics explored were overall attitudes towards wolves and current strategies for dealing with human-wolf conflicts.

Although the government has promised to compensate individuals who kill a wolf, they rarely follow through with this promise and many villagers do not have guns, which has led to increasing frustrations, more livestock losses and unreported wolf kills. Although villagers throughout Armenia use a variety of strategies to avoid conflicts with wolves, including lethal removal, lights, noise, fencing, traps, and poisons, many of the surveyed villages reported increased conflicts with wolves in recent years and many also expressed a need for support. Current wildlife management policies in Armenia are not effective in helping communities deal with human-wildlife conflicts, and conflicts with wolves seem to be further exacerbated by conflicts with management policies. This begs the question, what is the best strategy for poor villagers in rural mountainous Armenia to avoid conflicts? How can we transform the current situation from constant conflict to peaceful coexistence and stewardship?



Zoo visitors attitudes toward large carnivores in Slovenia

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ZOos play an important role in promoting conservation through providing learning opportunities through personal experience with wildlife and awareness raising educational activities. Both, personal experience and knowledge are factors that can influence attitudes toward large carnivores and thus improve their coexistence with humans in human-dominated landscapes.

In 2009, researchers from the Biotechnical faculty, University of Ljubljana have organized workshops about Slovenian large carnivore species at the Ljubljana ZOO. This was done as a part of the EAZA European Carnivore Campaign, which aimed to raise awareness of carnivore conservation within Europe. We assessed ZOO visitors attitudes toward large carnivores found in Slovenia at the time when activities took place. 640 visitors were asked to rate the statements for supporting (factor 1) or opposing (factor 2) conservation for all three large carnivore species found in Slovenia; Eurasian lynx (*Lynx lynx*), Gray wolf (*Canis lupus*) and Brown bear (*Ursus arctos*).

The results show that ZOO visitors generally support conservation of large carnivores in Slovenia (Factor 1: M_{bear}=4,42; SD_{bear}=0,61; M_{wolf}=4,41; SD_{wolf}=0,62; M_{lynx}=4,42; SD_{lynx}=0,60). Opposing conservation statements were on average rated much lower (Factor 2: M_{bear}=2,57; SD_{bear}=0,75; M_{wolf}=2,55; SD_{wolf}=0,77; M_{lynx}=2,42; SD_{lynx}=0,77). There were no statistically significant differences in ratings on supporting conservation factor between females and males. On the other hand, there were statistically significant differences found in ratings on opposing conservation factor, where females were more opposed to conservation of large carnivores than males (all $p \leq 0,001$). There were no significant differences in visitors' ratings according to their age on supporting conservation factor, but there were small but significant differences in their ratings on opposing factor for lynx and wolf.



A way of public relations: The "Kontaktbüro Wolfsregion Lausitz" (contact office "Wolves in Lusatia") in Saxony, Germany

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After 150 years of absence in Germany the first free living wolf pack was re-established in the year 2000 in Saxony. Since then wolves have been dispersing in Saxony and into other parts of Germany. With the recovery of wolves in a man used landscape the challenge is to deal with prejudices, changes in herding methods and human fears. To fight a lot of false information and questions about wolves by the public, the "Kontaktbüro Wolfsregion Lausitz" (contact office "Wolves in Lusatia") was established by the Saxony State Ministry of Environment and Agriculture in 2004 as the main information center about wolves for public, media and authorities. As part of the wolf action plan for Saxony in 2009 the public relations have been carried out by the contact office "Wolves in Lusatia" since then. Its goal is to inform the public about biology and behaviour of wolves, their distribution and methods to protect the livestock. The contact office informs on an unbiased level and bundles information based on facts obtained by the monitoring and livestock protection. More than 200 lectures per year are mainly given as environmental education workshops to students (59%) and speeches to mixed audiences (30%). The others are held in front of special interest groups like hunters, farmers and environmentalists. Since 2010 more than 500 pieces of evidence of wolves e.g. sightings, tracks have been reported to the office. The office also produces press releases and regularly written newsletters, it maintains the website www.wolfsregion-lausitz.de, which is always updated with current information about the distribution, scientific projects, livestock depredations or proved reproductions in packs. A wolf museum, which offers people the possibility to inform themselves on wolves through the exhibition and different movies on wolves and their recovery in a man used landscape, is also maintained by the contact office. Another responsibility is to supply the trained staff of each Saxon county with information and to help them with the public relations in their respective county.

The contact office "Wolves in Lusatia" is a unique facility unprecedented in Germany and Europe solely run by the state.



Genetic characterization of eastern coyotes in Atlantic Canada

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We will present a preliminary genetic characterization of eastern coyotes from the Atlantic Provinces, Canada. This analysis was prompted as a result of uncharacteristically aggressive behaviours noted among coyotes on Cape Breton Island, Nova Scotia, Canada, which included a fatal attack on a human in 2009. The taxonomy and population genetic structure of wild *Canis* spp. in Northeastern North America is complex and controversial. The three putative wild Canid taxa present in Eastern North America include gray wolves (*Canis lupus*), eastern wolves (*Canis lycaon*), and eastern coyotes (*Canis latrans*). Some have argued that while *C. lupus*, *C. lycaon*, and *C. latrans* are each derived from distinct phylogenetic lineages, there has been extensive current and/or historical hybridization among these taxa. Eastern coyotes have only recently dispersed into northeastern North America during the last century. Furthermore, they have only been documented in Nova Scotia, which is part of Atlantic Canada, in the past two decades. Eastern coyotes in particular have hybridized extensively with eastern wolves and several populations in Ontario, Canada, and the northeastern United States have been found to contain both mitochondrial haplotypes and microsatellite alleles that are characteristic of eastern wolves and “typical” western coyotes. We present a phylogenetic analysis of mitochondrial DNA haplotypes from eastern coyotes from Cape Breton Island and mainland Nova Scotia that demonstrates the presence of both *C. lycaon* and *C. latrans* mitotypes. Quantitative analysis of eight nuclear-encoded microsatellite loci is currently underway. In addition to our genetic analyses, we have collected data on body size variables (e.g., weight, girth, body length, tail length) and skull dimensions (e.g., width and length) as well as calculating an “aggression index” for trapped coyotes. These morphological and behavioural variables will be compared with the genetic data to test whether there is an association between eastern wolf (*C. lycaon*) genetic characteristics and larger body size and/or higher aggression index.



Wolves & the MHC: variability, hybridization and mate choice in the Italian wolf population

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Isolated small populations may experience low adaptability and increased extinction risks due to reduced genetic variability, especially if at important functional genes such as the Major Histocompatibility Complex (MHC). We investigated the variability of three class-II genes (DRB1, DQA1, DQB1) in the Italian wolf population, which was long isolated and is now expanding after a recent bottleneck. Compared to other populations, we still found a remarkable MHC variability, showing signatures of historical selection (high dN/dS ratio). The Italian wolves are known to hybridize with domestic dogs, and dog-derived MHC alleles were detected in some genetically-admixed individuals. Background microsatellite and MHC loci did not show reduced variability due to the recent bottleneck. Thus, the population recovery seems not to be threatened by reduced MHC variation nor by deep introgression of domestic dog alleles.

The observed variability could be also influenced by reproductive patterns, which can rely upon MHC similarity between mates. Based on pedigree data of wild-living packs, as reconstructed from extensive non-invasive genetic sampling, we tested the hypothesis of non-random mate choice in 26 breeding pairs. Results showed an unexpected prevalence of MHC-based assortative mating, with excess of peptide similarity between breeding pair members as compared to random expectations. Moreover, variation in both relatedness and heterozygosity showed significant positive correlations with fitness traits (total offspring, years as reproducers, mean offspring per year) deduced from pedigrees. These findings suggest possible advantages for breeders that are more related at the MHC, but not at the genetic background. This balance of general inbreeding avoidance, MHC-assortative mating and heterozygote advantage can reflect the social structure of the species, potentially maximizing the adaptation to the environmental pressures.



The wolf: killer or victim? Forensic DNA analysis or wildlife conservation

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The recent expansion of the Italian wolf population through the Apennine and western Alps, after centuries of contraction, is causing conflicts with human activities, in particular with hunters and livestock breeders, leading to a rise in poaching or illegal killings. Here we present some applications of forensic genetics, showing how molecular tools can be used to solve ambiguous cases regarding the wolf (*Canis lupus*).

Using 12 unlinked autosomal microsatellites, mtDNA control-region sequences, a male-specific ZFX/ZFY restriction-site and four Y-linked microsatellites, we reconstructed individual genetic profiles to establish the species and origin population of several forensic samples:

1) through the analysis of DNA extracted from a confiscated necklace made of ten presumed wolf canine teeth, we confirmed a case of suspect serial wolf killing. The individual genotypes obtained from the teeth belonged to six different individuals, which were unambiguously assigned to the Italian wolf population by Bayesian procedures;

2) in Europe, most of livestock predations are attributed to wolves, though free-ranging dogs are sometimes responsible for them, and false attacks are declared by breeders to obtain compensations. We analyzed 33 salivary DNA samples collected from the bitten skins of the carcasses of 13 sheep and a horse presumably predated by wolves in seven farms in Italy. We obtained reliable genetic profiles from ten of them, finding that eight sheep were killed by wolves, the ninth one by a female dog, while the horse was post-mortem consumed by a male dog;

3) finally, handcraft items sold in markets can illegally contain parts of protected animal species and are sometimes confiscated by the Italian forest police. We analyzed a suspect wolf fur coat sold as a souvenir, which turned out to belong to a North American wolf subspecies (*Canis lupus lycaon*).

These examples demonstrate that, when reference populations are genetically typed, forensic techniques can produce reliable information, contributing to the conservation of endangered carnivores such as the wolf and to better understand their real impact on husbandry.



Determination of livestock predators from salivary DNA

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The last two decades saw a sharp increase in small livestock breeding (especially sheep) in the Slovenian wolf presence area. The numbers of stray dogs is also on the rise since 1998 when a change in The Slovenian Hunter's Ethics code banned their culling. At the same time, the wolf population is making a recovery. This is increasing the possibility for livestock depredation events caused either by wolves or dogs. Livestock attacks that are attributed to wolves typically have a very detrimental effect on the tolerance of this species by the local communities. In the field or at a post-mortem, it is frequently difficult to recognize with any degree of certainty if the damage was done by a dog or a wolf, with wolves usually getting the blame. The answers in such cases can be provided by noninvasive genetics.

We collected saliva samples from around the wounds on livestock carcasses in predator attacks on livestock for three consecutive years, and analyzed ~500 samples collected at more than 300 damage cases. We analyzed 11 microsatellite loci for individual ID and SRY locus for sex determination. To distinguish between different canids living in the area we also analyzed a batch of tissue/saliva/hair samples for each of the species (wolves – 71; dogs – 47; foxes – 11; jackals – 27). A simple protocol for determination of the species was devised, and the assignments to wolf or dog reference group were additionally tested using genetic clustering software for a set of reference samples. Genotyping success was ~65%. We found a correlation between amplification success rate and three variables (weather, time between the kill and the sample collection, and sampling site). Predictions using the binomial distribution suggested that the species ID success depends mainly on the number of collected samples at the damage case, and the time passed between the depredation event and the collection of the samples. Based on our study the damage inspectors of Slovenia Forest Service are now routinely collecting saliva samples in situations where the perpetrator species is uncertain.



Social behaviour of Iberian wolf packs: a preliminary study based on footage obtained in the wild

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Most knowledge on social interactions among pack members is based on captive wolves, mainly due to the elusiveness of this species in the wild. However, behavioural traits recorded from captive wolves may differ from the ones living in the wild, raising the need for field studies on social behaviour of wild packs. This study aims to assess social behaviour in two breeding packs of Iberian wolves (Vez and Soajo packs) in Northwestern Portugal. Field data were obtained from footage recorded in rendezvous sites during three breeding seasons (July-September of 2008, 2010 and 2011) to obtain: i) pack size (min. number of adults and pups per pack); ii) individual identification of adult wolves based on morphological features; and iii) social interactions of pups and identified adult wolves.

Wolf individual identification was based on specific characteristics of each adult wolf related to coat patterns and other distinctive features (e.g. GPS collared; enlarged nipples). Behavioural types recorded for each identified individual were divided into three main classes: individual behaviours (self-grooming, resting, moving, other), interactions with adults (neutral, dominant, submissive) and interactions with pups (feeding, solicitation, socializing).

We were able to identify three adults from the Soajo pack (pack size of min. 5 adults and 5 pups), and six adults from the Vez pack (pack size of min. 8 adults and 8 pups). Due to limited sample size from Soajo pack, social interactions were quantified only in the Vez pack.

Individual behaviour prevailed in both pups and all identified adult individuals. Pups socialized with other pups more frequently (recorded in 49% of footage) than with adults (29%). Social interactions among adult pack members were not dominated by obvious agonistic interactions among them (e.g. dominance-submissive behaviours), in contrast to what is frequently described in captive wolves. Three adults, including the breeding female engaged more frequently in social interactions with the pups as compared to other adults. Although rarely addressed in available literature, our study demonstrates that individual identification of wild wolves based on coat patterns can be achieved and be a source of insightful information for social behavioural studies.



The wolf-prey-human system in Scandinavia—do we really need more wolf research *in situ*?

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Recolonizing carnivores can have a large impact on the status of other species in the ecosystem. These effects may include both direct lethal effects of predation and indirect effects on the behavioral ecology of prey and on other species including humans. Wolves (*Canis lupus*) have re-colonized the central parts of Scandinavia during the last 30 years and have been shown to primarily rely both on large ungulates, such as moose (*Alces alces*), and on the smaller-sized ungulate, roe deer (*Capreolus capreolus*). The preference for the two species is largely governed by their population density, which in turn affects territory size and ultimately the local density of wolves. Age structure of the moose population has implications for several components of wolf predation in Scandinavia, and kill rates are among the highest in the world. New establishments of wolf territories have important consequences for the local management of the moose population. Moose hunters in Sweden seem to respond functionally to a new wolf establishment by an instant reduction in moose harvest, especially on adult females. This may be considered as an adaptive management behavior in order to compensate for the increased mortality rate in the moose population imposed by wolves. At the wolf territory level, landscape structure is an important factor for the risk of predation as this may vary by several orders of magnitude within the same territory. This landscape effect is different for the two main prey species. Although moose are the primary wolf prey and landscape structure affects risk of predation, GPS-collared moose seem not to respond to local wolf establishment by altering their pattern of habitat selection as has been suggested elsewhere for prey meeting re-colonizing wolf populations. We conclude that few of our findings on wolf predator-prey ecology in Scandinavia could have been predicted from the scientific literature produced from other wolf-ungulate systems in the world.



Regarding the wolf's feeding behavior during wintertime in the Eastern Carpathians

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The wolf (*Canis lupus*) is an indigenous species of the fauna in the Eastern Carpathians (Ukraine). In the period 1969 – 2012, the annual average number of the predator here amounted to over 350 individuals, while the density was 0.1 to 0.15 individuals over the area of 1000 ha the lands suitable for being their habitat.

The wolf is a predator that preys on various kinds of animal. Its feeding behavior is determined by availability and accessibility of food. In places where there is enough natural food (wildlife), the wolf will not hunt domestic animals, it lives on the wildlife. The wolf's main food, under conditions of the Eastern Carpathians, is hoofed animals (*Cervus elaphus*, *Capreolus capreolus*, *Sus scrofa*). In the early 21-st century, among all the recorded wolf-induced death cases of hoofed animals, 70% of prey was deer, 22% - roe deer, and the rest was wild boar. However, the ungulate numbers in the Eastern Carpathians are insignificant making somewhat about 30 thousand of individuals. In wintertime, the region is not able to provide the wolf with sufficient amount of its natural food for various reasons. The most accessible food to the wolf in this period of time is domestic animals among them dogs in the first place.

We have analyzed wolf's feeding on dogs in the Skole Beskids (northeastern part of the Eastern Carpathians). It was found that of 22 villages situated in the Skole Beskids area, wolves' attacks on dogs were recorded for 18 settlements. It should be noted that no attacks on dogs (or death cases of dogs were minimal) in those villages through which run public roads of international significance, that is, roads with a heavy 24-hour traffic. In the village of Zavadka, a maximum number of wolves' prey – 22% of the total number of dogs – was recorded.

The first attacks on dogs are commonly observed late in September, the last ones in March. The dogs that became a prey to wolves were of various size, weight and age, some of them were featured by rather essential sizes. The dogs were attacked both by lone wolves and packs of 2 to 3 predators at different times of the day.

Thus, insufficient natural food (that is ungulates numbers) for wolves in the Eastern Carpathians during wintertime results in wolves' preying on dogs. 80% of settlements in the Skole Beskids (the Eastern Carpathians) have their dogs attacked by wolves. In order to reduce wolves' feeding on domestic animals, it is necessary to raise the numbers of ungulates in this region, to control the numbers of wolves by hunting, first of all, lone individuals, not territorial ones.



Persistence in time of wolf pack in Scandinavia

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The basic social unit of a wolf population is the pack. It usually includes a pair of two reproducing individuals located within a specific territory. Despite its fundamental role in the dynamic of wolf population, persistence and structure of wolf packs are overlooked. The use of presence-absence field data of packs have been used to create habitat occupancy models, to estimate population size and predict future trends in distribution range and numeric estimation of wolf population. But longitudinal studies based on the dynamic of recognizable wolf packs have been little studied, especially because of the lack of complete and long-term data. Here we used intensive and ongoing long-term field data collected by the Scandinavian wolf project to highlight the factors affecting the structure and persistence in time of more than 130 different wolf pairs and packs in Scandinavia. The Scandinavian wolf population is a well suited model because it is an isolated population, and its colonization and expansion of population range are well known. Our results investigate whether the intra-packs characteristics (i.e. inbreeding coefficient, pack size, reproductive success, turn-over of reproducing individuals) or spatial characteristics (i.e. prey density, human activities, and vegetation characteristics) influence the persistence in time of wolf packs in a human-modified landscape. Furthermore because of high additive mortality rate caused by poaching in Scandinavia, we expect a high turn-over of reproducing individuals and a low persistence in time of packs. Our results will help conservation policies, and look beyond numbers to include impacts and importance of the social dynamics of wolf packs.



Conflict management in free-ranging wolves (*Canis lupus*)

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Wolf sociality is characterized by benefits from group living due to cooperative breeding, hunting and territory defence, and costs due to competition for resources such as mates, food and space. Our study aims at understanding conflict management in free-ranging wolves (*Canis lupus*). As wolves live in stable social units, defend a territory, share long lasting individualized relationships, and experience within-group aggression, we expected conflict management strategies. By analysing 106 hours of video recordings, we collected detailed behavioural data about two packs in the Yellowstone National Park. Affiliative behaviours occurred earlier and more often after a conflict as compared to controls periods. Post-conflict affiliative interactions were primarily initiated by victims and were mostly directed towards the former opponent. Solicited and unsolicited consolation occurred, possibly highlighting benefits of conflict resolution for group members other than those directly involved in a conflict. The number of post-conflict affiliative behaviours was positively correlated with the number of aggressive behaviours, indicating that escalation of a conflict requires increased investment in conflict mitigation. The conciliatory tendency was relatively high (44.1 %) and comparable to the values reported in primate species with a relaxed dominance style. One specific affiliative behaviour was most often used for conflict management, but never observed in control periods. Our results suggest that conflict resolution mechanisms are a key component of the social life of wolves facilitated by clear but relaxed dominance relationships and promoted by the significance of group membership and cooperation in this highly social species.

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