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edited by
R. Chirichella, S. Imperio, A. Molinari, G. Sozio, S. Mazzaracca, D.G. Preatoni

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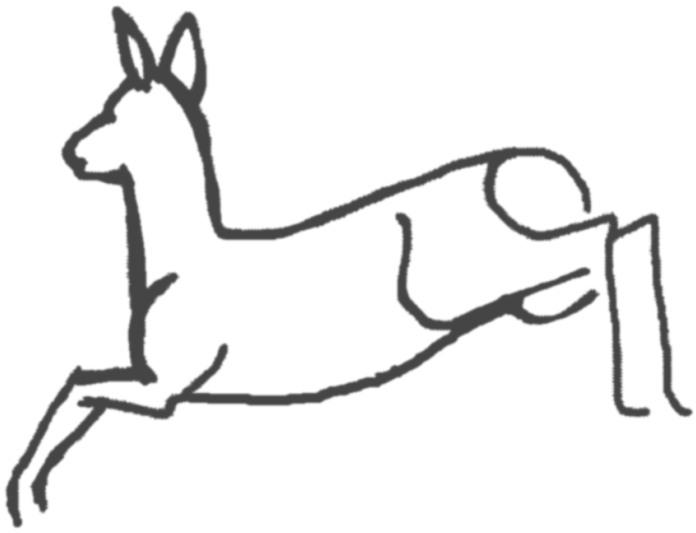

Mercoledí 20 Aprile 2016

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Mammiferi alloctoni: impatti, controllo e mitigazioni (in collaborazione con LIFE U-SAVEREDS)

Negli ultimi anni in Europa, e più in generale su scala globale, il numero di introduzioni di specie alloctone invasive è cresciuto in maniera esponenziale fino a rappresentare oggi una delle principali cause di perdita di diversità biologica. Rispetto agli impatti sulle attività antropiche, se da una parte sono evidenti le crescenti influenze economiche delle specie alloctone, le ricadute di queste introduzioni sulla salute animale e umana e gli aspetti sanitari sono stati a lungo trascurati. Le influenze congiunte sulla biodiversità, sull'economia e sulla salute pubblica sono pertanto destinate a sollevare un crescente interesse pubblico rendendo la problematica delle invasioni biologiche una delle maggiori sfide nell'ambito della gestione dei mammiferi, il gruppo con la più lunga storia di introduzioni tra i Vertebrati. Per fronteggiare efficacemente questa minaccia è sempre più necessario, sia a livello di approfondimenti conoscitivi attraverso la ricerca scientifica, sia per quanto concerne la definizione e la pianificazione di strategie gestionali e di prevenzione efficaci, promuovere interazioni e sinergie, anche a livello internazionale, volte a rendere risolutivi gli interventi attuati. Non a caso la collaborazione tra paesi europei per combattere le specie invasive è uno dei principi guida del Regolamento (UE) n. 1143/2014 del Parlamento Europeo e del Consiglio entrato in vigore nel 2015 ma pienamente operativo a partire dal 2016. La finalità di questa sessione congressuale, pertanto, oltre ad offrire l'occasione per un aggiornamento sullo *status* delle specie alloctone di Mammiferi, è quella di favorire il confronto, teorico e pratico, sugli aspetti strategici a scala nazionale e regionale, sugli approcci alla pianificazione degli interventie sulle modalità di attuazione degli interventi stessi. Tutto ciò in una prospettiva di efficace raccordo e interscambio di esperienze a diversa scala geografica e con il fine ultimo di predisporsi ad affrontare le criticità e le opportunità che deriveranno dall'applicazione del Regolamento (UE) n. 1143/2014.

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X Congresso Italiano di Teriologia

Alien mammals: trends, impacts at the global and local scale, and response strategies

Piero Genovesi
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C450 Opening Lecture

The analysis of mammals' introductions caused by humans provides a useful insight on the patterns of biological invasions, both because fossils permit to reconstruct the history of introductions also from ancient times, and because information on mammals is particularly detailed.

From the studies carried out on this topic in the last decades, it is possible to highlight that introductions of mammals have started in the Neolithic, but have dramatically accelerated in the last century, without showing any saturation effect so far. Along the millennia, pathways of mammals' introduction have significantly changed, and for example the role of accidental movement of species has decreased, while in recent times a major driver of introductions is the pet trade and more in general the intentional import of mammals for ornamental purposes.

The rate of establishment and the proportion of species causing impacts are particularly high in this taxonomic group, and invasive mammals cause higher impacts than most other taxa. These impacts can be caused by several mechanisms such as competition, predation, hybridisation, grazing, or trampling. Furthermore, invasive mammals may also cause impacts by the transmission of diseases, not only affecting biodiversity, but in some cases also impacting our health. Interestingly, invasive mammals of domestic origin are a significant cause of damage, requiring carefully tailored management responses.

In general to respond to the impacts caused by invasive mammals it is essential to prevent the arrival or establishment into the wild of the harmful species, and when prevention fails, consider the eradication of introduced populations when feasible, or carry on well planned permanent control.

Both prevention and management require a prioritization of actions. In the case of prevention, it is important to identify the most relevant pathways of introduction, and address them through coordinated regulatory and voluntary approaches. There have been significant advances in the prioritization of pathways, and there are increasing examples of effective approaches at reducing the rate of introduction of invasive mammals by targeting priority pathways; the recent EU Regulation on invasive species indeed provides a particularly interesting model in this regard.

For what concerns the management of invasive mammals, prioritization should consider the magnitude of the impacts that the species could cause, and the vulnerability of the species to the available management options. It should be noted that there have been significant progresses in the control and eradication of invasive mammals, with increasing benefits for affected native species; for example, a recent study noted as 596 populations of 236 native species on 181 islands benefitted from eradications.

At last, it is important to stress that public opinion plays a major role in the introduction and management of invasive mammals. Indeed this taxonomic groups raises a very high attention by the public, and in many cases the opposition of a part of the society have significantly limited the possibility to control introduced populations. Therefore a particular attention should be given to the interaction with the public and to an effective communication strategy.

X Congresso Italiano di Teriologia

Distribution, detectability and abundance of *Callosciurus finlaysonii* in a patchy landscape of southern Italy: a first assessment

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C265

Rapid, cost-effective detection and assessment of populations of alien species are pivotal management goals. Providing basic information on species distribution and ecological preferences allows researchers to generate a reliable picture of the invaded range, as well as to predict realistically the species' future range and assess its invasion potential and possible impacts. The Finlayson's squirrel *Callosciurus finlaysonii* is an arboreal rodent native to South-Eastern Asia but introduced to Italy, where it occurs with two disjunct populations in Piedmont (Northern Italy) and Campania/Basilicata (Southern Italy). We collected new presence records for the species through a citizen science campaign and used them to update its current distribution. We carried out fieldwork in the woodlands near the towns of Sapri and Palinuro (Province of Salerno), the northernmost boundary of the population in Southern Italy. We selected woodlots by visiting sites for which non-photographic citizen records were available. We applied field surveys, hair-tubes and visual sampling protocols to 1) assess the validity of non-photographic citizen science records, 2) compare methods for field detection of *C. finlaysonii* populations, 3) estimate the species' detection likelihood in relation to landscape characteristics.
All occurrence points obtained through non-photographic citizen-science records were validated in the field by direct observation of squirrels or by recording signs of their presence. We found that the species boundary in southern Italy has moved northwards with respect to previous knowledge, indicating that the range of *C. finlaysonii* in Southern Italy has largely expanded. Of the methods we tested, hair tubes were the most effective to detect *C. finlaysonii* presence. The species was abundant and easily detectable in the study area, also present in very small woodland patches in close proximity to urban areas. Our study offers basic information to implement a control strategy of the species in Italy and elsewhere outside its native range.

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Recostructing the phylogeography of an invasive species: tracing invasions routes of norway rats (*Rattus norvegicus*) using mtDNA control region

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C407

The norway rat, *Rattus norvegicus*, is a cosmopolite invasive species that moves especially following human routes. It is considered one of the worst pest, overall it may be dangerous for native species, agriculture and foodstuff. The norway rat reached Europe during XVIII century from Asia, but little is known concerning its invasion history and population structure in this area. Here we used the mtDNA control region to study pattern of invasion of *Rattus norvegicus* by a phylogeographic approach. We used 385 rat sequences, 174 collected from Europe, Africa, Thailand and Middle East and 211 retrieved from GenBank. Despite the very recent invasion of Europe, the results show an unexpected high genetic diversity. Twenty-six haplotypes were recognized and we built a Maximum Parsimony (MP) tree to identify the relationship between them. In the MP tree we identified three aplogroups that are also recognizable in the Statistical Parsimony (SP) network. Two of them show a star-like structure in the SP network suggesting populations expansion. This structure, corroborated by mismatch distribution, Tajima's D and Fu's Fs neutrality indices, suggest a recent sudden expansion of the populations in Europe and Africa. In addition, the different geographical distribution of the haplogroups suggests the occurrence of two different invasion events in Europe possibly along two different colonization routes: an African route and a Middle East one. Furthermore, some haplotypes are shared between Europe and other invasive areas. This suggests to consider Europe as a possible new source area for *Rattus norvegicus*. Among the European countries, Italy has the highest genetic diversity, probably due to a recent introductions from different sources. For 117 specimens, 18 selected from our samples and 99 retrieved from GenBank, we performed an additional phylogeographic analysis using the cytochrome b as molecular marker. We built a network to identify the geographical distribution of the haplotypes according to the Statistical Parsimony method. The structure of the cytb network supports the hypothesis of at least two separate routes of colonization of Europe.

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Understanding invaders: how easy indices of fecundity and body condition may aid management

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Most of invasive alien species (IAS) need to be controlled to avoid or reduce damage on native species and ecosystems, agriculture and livestock, human health and infrastructures. Since IAS population growth rate may vary across sites depending on intrinsic and habitat characteristics, investigating population dynamics parameters specific to the area of intervention is important to precisely quantify impacts of IAS and plan effective control strategies. In particular, knowledge of the reproductive output is essential for the definition of adequate harvesting quotas, while measures of body condition may help to pinpoint populations that are thriving and identify factors promoting invasiveness, thus allowing for the definition of priority areas or periods. Unfortunately, most methods commonly used to investigate reproductive output (e.g. capture-mark-recapture) and body condition (e.g. body mass-length ratios) in mammals are often time consuming and/or imprecise. Here we propose two less known methods that may be easily used on carcasses obtained from control campaigns to gain information on IAS fecundity and body condition: uterine scars counts and bone marrow fat proportion. To evaluate the feasibility and reliability of these techniques, we made use of carcasses of two invasive tree squirrel species introduced to Italy, Eastern grey squirrels (*Sciurus carolinensis*) and Pallas's squirrels (*Callosciurus erythraeus*), that were collected between 2013 and 2014 within a European Community LIFE project (LIFE09 NAT/IT/00095 EC-SQUARE).

To determine fecundity (n. of youngs weaned/year) of female squirrels we adapted a staining technique that allows to distinguish the number of scars left at birth by the detachment of each embryo's placenta from the endometrium. We collected uteri from 44 adult grey squirrels and 31 adult Pallas's squirrels trapped at the end of the last breeding season (late autumn-early winter) and stored them at -20 °C in clean tap water until later examination. Each uterus was then opened over its entire length and stained by the Turnbull reaction, which reveals dark pigments of macrophages involved in tissue repair processes. Scars were examined under a microscope within one hour from staining and classified based on their coloration, with light-stained scars indicating earlier litters and darker scars more recent parturitions. Analysis of uterine scars revealed that grey squirrels produced a maximum of two litters/year, with total fecundity between 0 and 8 youngs/year and an average of 3.4 scars/female. Number of uterine scars differed between breeding seasons, with females that reproduced in both seasons producing on average a larger summer than spring litter. Pallas's squirrels produced up to 3 litters/year, with total fecundity between 0 and 9 youngs/year and an average value of 3.1 scars/female. In this species, fecundity was positively affected by female body mass, foot length and age. Overall, our data show that fecundity of both squirrel species in the introduction range is comparable or even higher than values reported for their native ranges.

Body condition was evaluated on 58 grey squirrels of both sexes by determining the proportion of fat contained in femoral bone marrow, a parameter that had been previously applied on ungulates where it is considered a good index of body condition. Bone marrow was extracted directly from frozen femurs, weighed to nearest mg and then dried at 60 °C for 24 h. After drying, each sample was weighed again and the percentage of fat contained in bone marrow was obtained based on the ratio between dry and wet sample weight. Proportion of fat in femoral bone marrow of grey squirrels ranged between 21% and 87%, it significantly increased with body weight and was affected by season, reaching maximum values in spring and a minimum peak during autumn. Statistical analysis showed that, compared to body weight, bone marrow proportion has both a higher coefficient of variation and a stronger relationship with biological and biometric variables that may influence individual nutritional condition, indicating that this measure represents a reliable parameter to define squirrel's body condition.

Overall, our results indicate that uterine scars counts and bone marrow fat content offer good estimates of fecundity and body condition in squirrels. As a consequence, they represent two practical and cost-effective methods that may help to improve impact assessment and management strategies of IAS by providing key data for estimating population growth rates essential to define establishment likelihood and control measures.

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Ecology, management and impacts of the invasive Pallas's squirrel in Italy

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C232

Invasive alien species (IAS) can alter the natural evolution of the native ones by competitive exclusion, hybridization, predation and niche displacement which can, ultimately, result in native species extinction. The outcome of the invasion process may be affected also by parasites, and infection transmission can become a threat to native species and human health. The best way to deal with the threat represented by IAS to biodiversity and society is through a combination of applied prevention measures, early detection and, when prevention fails, management and eradication of established invasive species.

The invasive tree squirrel *Callosciurus erythraeus* or Pallas's squirrel, native to Southeast Asia, has been introduced in Northern Italy. In particular this research was focused on the competitive interactions between the co-occurring native Eurasian red squirrel and the Pallas's squirrel. The research went through the necessary steps to identify the new alien species, its distribution and effects on native species, and the best management actions to control it. The Pallas's squirrel is well adapted to the new environment and has a high reproductive rate and potential to spread. This is related to its ecology but also to the new environment that provides a good availability of food resources as demonstrated by the high density of invasive squirrels in the area. Moreover the confirmed parasite release may result in increased reproduction and/or survival. Co-occurring red squirrels are not yet locally extinct but are strongly affected by interspecific competition. Pallas's squirrel successfully competes for food resources with the native red squirrel that is gradually disappearing from the area. Adult red squirrels are not affected by space use competition; nevertheless the native species mainly occurs at the borders of the distribution area of Pallas's squirrels which occupy high-quality habitat patches. These border areas are generally of lower quality in terms of forest composition, human disturbance and degree of fragmentation, which negatively affects persistence of the red squirrel population, in particular local survival and consequently population density. The removal program (LIFE09 NAT/IT/000095 EC-SQUARE) did not reach the complete eradication of the Pallas's squirrel in 4 years, mainly because of insufficient trapping effort in relation to the habitat type (mainly continuous forests) and the high reproductive rate of the species which apparently compensates for the reduction of adult density. However, the removal in some trapping areas allowed red squirrels to recolonize these areas. Thus, considering the interspecific competition, the eradication of the Pallas's squirrel in Italy is imperative to protect the long-term survival of the native squirrel population. A long-term commitment and adequate resources, supported by the current ban of the species from pet trade, will be crucial to achieve this result. Hence, the next management plan with higher trapping effort and better trapping efficiency supported by alternative control methods, such as planned shooting, should improve the efficiency of the management of this alien species and help the conservation of the native red squirrel.

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A short reflection on recent trends in wildlife protection in Italy

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C225

Recently, several authors have on more than one occasion proposed the exclusion of known anthropochorous mammalian *taxa* from conservation lists, followed by implementation of ulterior protective legislation, as a necessary measure to maintain the uniqueness and richness of biodiversity. In this sense, many populations of vertebrates are to be excluded from the international conservation lists, including all the "non-autochthonous" species that now enjoy a both continental and insular diffusion. Speaking of Italy alone, this would be true of the majority of the lagomorphs and ungulates, as well as several species of rodents. Thus, we would have to cancel many of the species from the recent *IUCN Lista Rossa dei vertebrati italiani*. Not to mention almost all the non-volant terrestrial mammals which are now diffused on the Italian islands. If we do not wish to take into consideration the historic and cultural value, as well as biological, of many populations of anthropochorous origin, they would all be eradicated from their current territories of diffusion — where they have been introduced many millennia ago — in the name of an unbelievably partial retrieval of natural ecosystems (irretrievably lost thousands of years ago) which could have unimaginable consequences for these ecosystems, or for what remained of them.

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A multidisciplinary approach to the management of charismatic invasive mammals in urban areas: insights from a grey squirrel case study

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C435

The successful eradication of Invasive Alien Species can produce significant effects for the recovery of native biological diversity. Nevertheless, plans aiming at their rapid eradication or control, as foreseen by the new EU Regulation n. 1143/2014, may encounter several difficulties, especially when dealing with the management of charismatic mammals. In this respect, the Eastern grey squirrel provides an emblematic example. It is an aesthetically appealing mammal, particularly appreciated by the general public, and programs aiming at its management may encounter the opposition of animal right groups. In Italy, social clashes indeed hindered planned control efforts.

The question of how to address the grey squirrel management issues is still topical. Some programs carried out within the framework of the LIFE EC-SQUARE Project (LIFE09 NAT/IT/095) locally achieved the eradication goal, but others are still implemented to control the widespread populations in the North-West of Italy, and a new deme of grey squirrels has been detected in Umbria, central Italy. Here, the LIFE U-SAVEREDS Project (LIFE13 BIO/IT/204) aims at eradicating grey squirrels from an area of 50 km^2, centred on the city of Perugia and from which the species could invade the entire Apennine region, representing a threat for the conservation of the native red squirrel (*Sciurus vulgaris*).

Taking into account the evident role of social issues in the management of the species, U-SAVEREDS initially focused on the analyses of the social background of the Project area, also by administering a questionnaire to verify the attitude of citizens towards humane removal of the animals.

At the same time, we collected data on the presence, abundance and actual distribution of the grey and red squirrels in Umbria. By observations from points of sighting, we estimated the minimum number of animals in the known grey squirrel range. Direct observations and camera-trapping surveys implemented at the margins of the Project area allowed to verify the presence of the species in new sites, located North-East of the city of Perugia. Overall, the ratio between the grey and red squirrel was heavily biased in favour of the non-native species. The latter is now widely distributed and probably expanding its range, while the red squirrel persists in a few areas within the grey squirrel range and shows a clumped, shrinking distribution.

These data also highlighted that in Umbria the grey squirrel range overlaps with an extremely heterogeneous environment. The range is centred on a wildlife park, but grey squirrel sightings are also recorded in the main urban park of Perugia and in small green areas interspersed with buildings, while the most peripheral part of the species range overlaps to rural areas, characterised by the presence of scattered houses with attached private gardens and allotments.

This heterogeneity translates into different attitudes, with groups of stakeholders who are opposed to the project and others who understand its motivation and provide their support. Since, for eradication to occur, being unable to access even a small percentage of woodland areas may be detrimental, the implementation of an appropriate communication plan emerged as a priority in the LIFE U-SAVEREDS Project for gaining access to most of the private properties. For this purpose, we focused on the activation of local opinion leaders to spread the motivation behind the project, as well as on activities designed to create a direct link between citizens and the local Agencies responsible for Project actions. A conflict manager was charged to guide the technical staff in addressing the concerns of the public and, though most of the control was planned with live-trapping and euthanasia of the animals, surgical sterilization with subsequent release of a limited number of grey squirrels was also planned, in order to reinforce the positive messages of the Project and to demonstrate helpfulness towards the demands of the various stakeholders.

In this framework, a further challenge was to identify spatial intervention priorities, taking into account the complex socio-ecological mosaic and without raising severe social conflicts. The need for a structured and multidisciplinary decision making technique was fulfilled through the development of a Decision Support System based on a Bayesian Belief Network, providing the first example of application of this tool to the management of the Eastern grey squirrel. The adoption of this model promoted a shared conceptual understanding of the system being managed and it provided a useful tool to communicate with non-experts about management decision.

In the LIFE U-SAVEREDS Project, the Decision Support System responded to the need of transparency in the management decision process. Thanks to its flexibility and to its multidisciplinary approach, it provides an innovative example of how to face the challenges of invasive species eradication posed by the EU Regulation entered into force in January 2015.

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Disease Risk Assessment and Invasive Alien Species: developing a methodological approach to evaluate the risk of introduction of new infections and spread of local ones

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C385

Invasive alien species (IAS) represent one of the main global threats to biological conservation and can even exert a great impact on human activities. To cope with this issue, the European Community has recently approved a Regulation (Reg. EU No 1143/2014) to define a common intervention line. According to this Regulation, a list of invasive alien species considered to be of Union concern has been defined and will be regularly updated in order to define priority interventions. Although infectious diseases may play a relevant role in the establishment of IAS and have dramatic impacts on human health, economic sustainability of animal farming and biodiversity conservation, diseases are rarely included into evaluations due to the methodological complexities of their risk assessment. Every mammal species can be indeed infected by up to hundreds of different parasites which can be transmitted to humans, domestic animals and other wildlife. Alien species may thus act as carriers of new infections in the area of release, or as new competent hosts for autochthonous infections, amplifying their local transmission and maintenance. Here we used raccoon (*Procyon lotor*), coypu (*Myocastor coypus*) and grey squirrel (*Sciurus carolinensis*) as model species to develop a qualitative methodology for Disease Risk Assessment that allows to assign each IAS into one out of four discrete risk categories.

Assignment to these categories is obtained by scaling the likelihood of infection occurrence over its impact, with each of these two elements defined in turn through four discrete categories.

Hazard assessment, determined through the analysis of existing scientific literature, identified a total of 377 parasite species reported in 388 scientific papers.

Thus, for each infection, we defined the impact and likelihood of their introduction or local amplification in relation to transmission to humans, domestic animals or other wildlife. Based on these data, for each of the three IAS we assessed the risk towards humans, domestic animals and other wildlife relative to the introduction of new parasites and the amplification of local ones. Additionally, for each host species we obtained a total disease risk evaluation that included all these partial aspects. Concurrently, we also carried out evaluations to determine the uncertainty level associated with each of the risk estimates.

Our analyses showed that the raccoon is the IAS infected by the highest number of parasite species (n=198), followed by grey squirrel (n=136) and coypu (n=44). The risk of introducing new parasites is thus higher for the raccoon, which may carry 37 high risk parasites: 16 zoonotic, 12 transmissible to domestic animals and 9 to wildlife. On the contrary, coypu presents the lowest risk of introducing new parasites with only 2 high risk parasites transmissible to humans and wildlife and 1 to domestic animals. Similarly, even the risk of amplifying local parasites is highest in raccoon, which may be infected by 16 parasite species that represent a high risk for humans and 6 for domestic and wild animals. Coypu resulted again the least risky species, with 4 high risk infections for humans and wildlife and 2 for domestic animals.

As a consequence, the overall disease risk is higher for raccoons with 27 high risk infections for humans, 15 for domestic animals and 12 for wildlife, whereas coypu is the least risky species with 5 infections for humans and wildlife and 2 towards domestic animals. Finally, the risk estimates relative to raccoon shows the highest level of uncertainty and respect the coypu's the lowest level.

These results show that some alien species, despite having a relatively low impact on biodiversity and human economy, might indeed entail high disease risks, whereas species with a high environmental impact may pose negligible disease risks.

The present methodological approach represents a first step towards a broader development of a disease risk analysis on a more comprehensive number of invasive alien species. Other than providing information on disease risk, the output of this assessment can serve as a guideline to indicate those knowledge gaps that should be covered. In particular, disease risk assessment should integrate experts' opinions that define likelihoods of infection of less investigated parasite species with a participated involvement of stakeholders to better incorporate the perceived impacts. Once these results will be achieved, risk management plans to mitigate the potential disease impact posed by IAS could be defined.

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That's the press, baby! the press! But there's something you can do about it. The management of the grey squirrel seen through the eyes of the media

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Invasive non-native species are known to be one of the major threats to biodiversity. Although the scientific community widely agrees with the necessity to manage and control invasive species, the public opinion often may not support some of the management activities, especially if the species have a strong "appeal' to the public, such as the case of the Eastern Grey Squirrel *Sciurus carolinensis*. This could potentially lead to a failure of management plans or, at least, complicate their progressions. The public opinion could be affected by mass media, in particular when the audience has little experience with a particular issue (media-dependency hypothesis). A good communicative campaign could increase the acceptance of management activities and the probability of success, while a poor campaign may lead to more problems or even failures. In a media-saturated society the information reported by the press could be considered as an indicator of the public attitude. Consequently this information may be used to evaluate the public opinion, and therefore the effectiveness of the communicative campaign performed by a project.

A media content analysis, both qualitative and quantitative, has been used to assess the effectiveness of the communication campaign of the LIFE EC-SQUARE project on the management of the grey squirrel in Lombardy, Piedmont and Liguria. From 2011 to 2014, most of the information sources available to the public, such as newspapers, magazines, web news, radio and television programmes, were collected and analysed in searching the information concerning the project. Each piece of news was then classified adopting two techniques, the key words approach and the syntactic analysis approach, and allocated into three categories: "favourable", "neutral" and "contrary" to the project. In total we considered 173 articles published on the project in the four years. Overall, 50% of the articles regarded activities of the project in Liguria, 17.5% in Lombardy, 4.2% in Piedmont and 28.3% the whole project without a geographic focus (χ^2_3=74.67, p<0.05). This higher interest of the media for the activities in Liguria was probably connected to the management actions conducted in urban parks, where citizens used to feed the animals.

The frequency values of the three categories were different between the three regions involved in the project, including articles without a clear geographic focus (χ^2_6=28.16, p<0.05), with a higher frequency of negative articles in Liguria in respect to the other regions. Therefore, in Liguria the project encountered a greater initial opposition, despite the management solution proposed was based on the surgical sterilization of squirrels and not their live-trapping and euthanasia as in the other regions. However, the number of negative articles focused on Liguria decreased from March 2013 till the end of 2014 ($F_{1,7}$=6.05, p<0.05, R^2=0.46), indicating an effect of the local communication campaign. In general, each frequency peak of newspaper articles against the project was followed by a peak of favourable news, demonstrating the effectiveness of the communicative campaign of the project in the reduction of negative opinions. Furthermore, during the project the trend was reversed, with peaks of positive articles, stimulated by the project, before a reaction of opponents to the projects generating negative feedbacks in the media. The determination of a single journalist could modify significantly the frequency of some categories, with a substantial increase in negative or positive articles that could influence the public and local stakeholders and, therefore, the outcome of the project. In our case, among 54 journalists who published on the project, nearly all of them published 1–3 articles, while just one of them reached a peak of 19 articles (χ^2_{53}=209.14, p<0.05), mostly against the project. From the trend analysis the Issue Attention Cycle hypothesis has also been supported: the interest of the media was not regular during the period analyzed, but it followed cycles of high and subsequent low attention.

From the combination of both qualitative and quantitative media content analysis it is possible to evaluate the effectiveness of a project communication campaign, and indirectly the public opinion and attitude. Monitoring the effectiveness is fundamental for an early correction of the communicative activities, allowing an increase of the effort in periods with peaks of news against the project. Furthermore, it is important to establish a proactive approach, planning the communication so to generate positive feedbacks in the media without waiting the action of groups working against the project. This aspect could potentially be one of the keys to the success of a management project, especially when the species has a strong emotional impact on citizens.

Presentazione delle *Linee Guida sul recupero e la riabilitazione dei Chirotteri in Italia*

X Congresso Italiano di Teriologia

Linee Guida sul recupero e la riabilitazione dei Chirotteri in Italia

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C452

I Chirotteri, con le attuali 34 specie, rappresentano un terzo della mammalofauna italiana e uno dei gruppi maggiormente minacciati.

Il cambiamento di immagine dei pipistrelli presso il grande pubblico, grazie alla crescita delle attività di ricerca e di divulgazione, ha determinato negli ultimi anni un aumento della raccolta di individui trovati in difficoltà. Pertanto il recupero e la riabilitazione sono diventati un settore importante, sia per i chirotterologi, sia per coloro che si occupano di recupero della fauna selvatica, come i centri di recupero e i veterinari.

I Chirotteri sono animali estremamente complessi, sia per la fisiologia, sia per il ciclo biologico. Trattando le varie specie bisogna avere una conoscenza profonda di questi aspetti, per poter avere delle buone probabilità di esiti positivi.

Inoltre è forte l'esigenza di trovare dei protocolli condivisi nella gestione dei Chirotteri trovati in difficoltà. I CRAS spesso utilizzano metodologie diverse, non uniformi e, vista la quantità di animali e le diverse specie ricoverate, non è semplice per questi centri reperire informazioni sulla corretta gestione di animali così esigenti.

Quindi si è delineata da più parti la necessità di redigere delle linee guida che possano trattare i principali aspetti del recupero in maniera corretta, come le tecniche di allevamento degli orfani, il mantenimento in cattività e le modalità liberazione, nonché gli aspetti educativi e di diffusione presso il grande pubblico. Sono affrontate anche le problematiche correlate alle patologie più frequenti e il loro trattamento.

Uno degli obiettivi principali è la creazione di una rete nazionale di operatori accreditati da un percorso formativo, che possano assicurare le corrette procedure sanitarie, la raccolta standardizzata dei dati relativi alle specie, le colonie di provenienza, le liberazioni, le patologie e i trattamenti medici, attraverso un archivio nazionale informatizzato.

In occasione del Primo Convegno sul Recupero e la Riabilitazione dei Chirotteri in Italia, svoltosi a Sasso Marconi (BO) il 27 e 28 febbraio 2016, i principali esperti italiani di recupero dei Chirotteri, anche facenti parte del GIRC (Gruppo Italiano Ricerca Chirotteri), hanno redatto una prima bozza delle linee guida. Questo documento è stato condiviso con ISPRA prima del Convegno, e successivamente presentato in una sessione di concertazione aperta a tutti i partecipanti, affinchè potesse essere il più completo possibile.

Il percorso di condivisione è sfociato al X Congresso Italiano di Teriologia, con l'obiettivo di renderlo uno strumento efficace per tutte le figure professionali coinvolte a vario titolo nelle attività di recupero e di monitoraggio dei Chirotteri.

Tavola Rotonda: Atlante Italiano dei Mammiferi, verso una nuova *vision*

Le moderne tecnologie hanno permesso una sostanziale evoluzione delle modalità con cui i dati dei grandi inventari naturalistici (meglio noti come "atlanti") vengono raccolti, scoprendo scenari un tempo impensabili. In particolare, tali mutamenti riguardano le modalità con cui i dati possono essere raccolti e trasmessi e l'incremento della platea dei rilevatori. Con la diffusione di strumenti come gli *smartphone*, provvisti di rilevatori GPS e fotocamere versatili, c'è l'opportunità di raccogliere e trasmettere in tempo reale dati faunistici, con possibilità di validazione pressoché immediata. Inoltre, tali strumenti rendono possibile la partecipazione alle campagne di segnalazione da parte dei cittadini. Tale approccio, comunemente noto come *citizen science*, permette di coinvolgere nella raccolta dei dati anche persone non strettamente addette ai lavori, con importante ritorno in termini di aumento di consapevolezza e disseminazione delle problematiche inerenti la conservazione della biodiversità. Tali approcci hanno fatto breccia in molti settori, e, per rimanere all'esempio italiano, interessano ormai molti gruppi faunistici, *in primis* gli uccelli (cfr. `ornitho.it`). Benché i Mammiferi differiscano sostanzialmente dagli uccelli per quanto riguarda la difficoltà di rilevamento e la corretta identificazione delle specie, questa sfida è comunque un'opportunità da cogliere, con la realizzazione di un atlante dei Mammiferi basato sulle segnalazioni di un'ampia compagine di rilevatori, con necessità di validazione dei dati da parte di esperti. L'importanza di tale iniziativa permetterebbe un importante passo verso una più completa conoscenza della distribuzione delle specie di Mammiferi italiani, ad esempio per la rendicontazione ai sensi dell'art. 17 della Direttiva Habitat, ma senza dimenticare gli importanti risvolti che tale banca dati potrebbe avere per molti altri scopi (pianificazioni e valutazioni ambientali, attività di ricerca e modellizzazione, etc), in particolare se condivisa da diverse comunità scientifiche.

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X Congresso Italiano di Teriologia

Atlas of Mammals of Veneto: results of a web platform 100% open source

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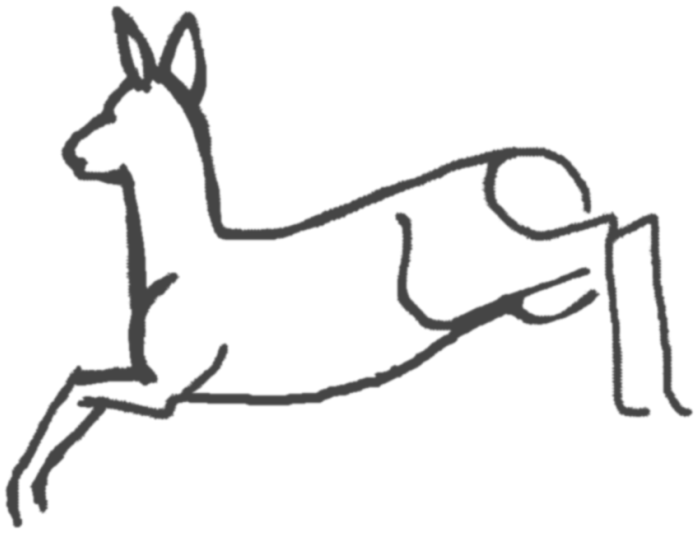
Association of Faunists of Veneto `www.mammiferiveneto.it`

Since 2009 the "Associazione dei Faunisti Veneti" (AsFaVe) has supported the development of a web platform to record signals of mammals in Veneto, collaborating with the Museum of Natural History of Venice (MSN). The aims of project are: 1) the publication of a dynamic atlas and 2) the development of a permanent operational tool which manages faunal data from public institutions and naturalists.
The web platform is entirely based on Open Source technologies. The main components are: an operating system (Linux Ubuntu), a web server (Apache HTTP Server), a relational database management system (MySQL), a PHP web application framework for MVC applications (Symfony), an application server (Tomcat), a server for sharing geospatial data (Geoserver) and a javascript library to load, display and render maps on web pages (OpenLayers library).
An open source web browser can be used to access to the database by user authentication. Geographical information is managed by a WebGIS system, which allows to georeference territorial data upon maps such as Google Maps, Yahoo Maps, OpenStreetMap and Virtual Earth.
The whole platform was created in order to read and query data into web directly or through a GIS software (WMS/WFS services or vectorial files such as `.shp`, `.kml`, `.kmz`, `.csv`).
Beyond standard information, for each record there are, also, these qualitative parameters: 1) security level on species identification (based on 5 levels), 2) precision time interval, 3) author of the record and 4) data verifier.
To date in the database were recorded n. 90728 reports of mammals (since 1990). The database has been populated thanks to the voluntary participation of n. 74 users: 20% of data was recorded by public Institutions, while 80% from naturalistic associations and private naturalists.
Taking into consideration only high quality data (punctiform features) n. 52249 (58%), the project has allowed to assess the presence of n. 108 mammal species.
The most common reports are linked to hunting, n. 16122 (31%), carcasses of other origin, n. 11889 (23%), occasional sightings, n. 5299 (10%) and surveys, n. 4722 (9%).
The most common species recorded in the database are referred to Ungulata, n. 29506 (56%), among which *Capreolus capreolus c.* (n. 14739) and *Rupicapra rupicapra* (n. 6793).
N. 6302 records (12%) are referred to Rodentia among which n. 1059 are *Sciurus vulgaris* and n. 630 are *Myocastor coypus*.
N. 5503 records (11%) are linked to Carnivora, largely represented by *Vulpes vulpes* (n. 2902), *Meles meles* (n. 1034), and *Martes foina* (n. 533).
N. 4719 records (9%) are referred to Lagomorpha, among which 94% are *Lepus europaeus*.
N. 3028 records (6%) belong to Insectivora with a prevalence of n. 946 *Talpa europaea* and n. 918 *Erinaceus europaeus*.
In addition, n. 1377 (3%) of records are linked to Chiroptera (the most represented species: *Pipistrellus kuhlii*, n. 451).
Overall, in relation to the security level on species identification, data recorded are of high quality: n. 50077 (96%) are characterised by a security level, equal to 4 or 5.
The web platform of the project "Atlas of Mammals of Veneto" allows to share the IT structure in order to record data of any other geographical area. Moreover, its "flexibility" permits an easy customization to satisfy needs and purposes of other projects.



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Mammiferi: impatti ecopatologici, antropici e gestione (in collaborazione con SIEF)

In relazione al loro impatto su tassi di mortalità, riproduzione e reclutamento, gli agenti patogeni (micro e macroparassiti) rientrano tra i fattori che possono maggiormente influenzare, seppur in misura e con modalità differenti, la dinamica delle popolazioni selvatiche. Di conseguenza, l'indagine ecopatologica rappresenta uno strumento importante per la comprensione dei meccanismi che regolano le popolazioni animali e per la corretta pianificazione di strategie gestionali e conservazionistiche. Inoltre, le specie animali selvatiche possono svolgere un ruolo di rilievo nei cicli di trasmissione di infezioni a valenza zoonosica e/o zoo-economica, nonché nell'emergenza di patologie. Tale aspetto genera sovente una conflittualità tra le necessità gestionali a livello di sanità pubblica e a livello di conservazione della biodiversità, rendendo ancor più fondamentale una corretta interpretazione delle dinamiche epidemiologiche ed ecopatologiche. Questa sessione si propone quindi di affrontare i temi riguardanti la definizione dello stato sanitario delle popolazioni selvatiche e dei meccanismi che regolano il rapporto ospite-parassita e la dinamica delle popolazioni selvatiche, con particolare attenzione al legame tra gli aspetti ecopatologici e conservazionistici e alle problematiche gestionali inerenti l'interfaccia tra fauna e sanità pubblica.

Coordinatori

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X Congresso Italiano di Teriologia

Chernobyl and the wild boar: 30 years of history

Fabio Mantovani
University of Ferrara - National Institute for Nuclear Physics

C449 Opening Lecture

On 26 April 1986 a severe incident occurred at the reactor four of Chernobyl nuclear power plant. The subsequent explosion and fire released approximately 14×10^{18} Bq of radioactive substances into the atmosphere. The fallout of radioactive isotopes affected an area of more 210^5 km^2 in western USSR and Europe. Approximately 0.6% of the total radioactivity was constituted by ^{137}Cs, one of the radionuclides with the greater impact on the environment.

The X Italian Congress of Theriology (20–23 April 2016) is organized few days before the 30th anniversary of Chernobyl disaster. In addition the half-life of ^{137}Cs is approximately 30 years.

Arising from these coincidences, the plenary lecture focuses on the physical and chemical properties of ^{137}Cs, which is generally chosen for mapping the radioactive fallout since it is particularly easy to measure. It has a relevant radiological significance due to its biological behavior similar to that of potassium.

In the long term, ^{137}Cs in meat, in milk and in vegetables remains the most important contributor to human internal dose from anthropogenic radionuclides. During the last decades the ^{137}Cs activity concentration, in both vegetable and animal foods, has been decreasing very slowly, at the rate of 3—7% per year. On the base of some recent measurements performed on the top soils of Alps in Veneto Regions, the reasons of this peculiar behavior in the environment will be discussed.

Since the transfer of ^{137}Cs from soil via plants and mushrooms to animals is much higher in forest ecosystems than in agricultural environments, the levels of radiocaesium measured in the wild boar meat will be reviewed. Due to the way of feeding of these suidae, they are considered useful indicators of anthropogenic radioactivity in the environment, especially in the forest ecosystems.

X Congresso Italiano di Teriologia

Presence of ^{137}Cs in wild ungulates in the province of Verbania (Western Central Alps)

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Cesium-137 (^{137}Cs) is an alkali metal radioactive isotope of cesium, which is mainly formed as by-product of uranium nuclear fission, especially in nuclear fission reactors. ^{137}Cs can be usually found in the environment due to anthropogenic contaminations. In Europe, however, it mainly occurs as a result of the Chernobyl accident fallout. Due to rainfall distribution during the days right after the accident and to different soil characteristic, ^{137}Cs content is irregularly distributed in the territory. Such a situation produces very modest risk associated with exposure, but on the other hand it makes the identification of affected areas very complicated. Concerning Italian Alps, ^{137}Cs contaminated areas were detected mostly in the Western Central Alps, Larian Triangle and Eastern Alps. Furthermore ^{137}Cs was detected mostly in Alpine environment, compared to plain territories which seem to be free from contamination. In the plain agricultural areas, though, other factors can strongly influence contamination concentrations, such as dilution and mixing do to plowing and soil movements due to land management.

Several studies show a relationship between soil and environmental characteristics and ^{137}Cs presence. Furthermore plants are able to mobilise this isotope removing it from soil and making it bio-available for domestic and wild ungulates with possible entries into the food chain.

According to this complex situation, collecting samples from wild ungulates shot in a regular hunting season, can provide useful information in order to assess the radionuclide presence and distribution in the territory.

The study area is the Verbania province, a mountainous territory of the Western Center Italian Alps. Muscle samples (diaphragmatic muscle or tongue) of 819 wild ungulates have been collected to the control center during two regular hunting seasons (2013–14 and 2014–15) and control program for only wild boar. The samples were distributed as follows: 98 chamois (*R. r. rupicapra*), 152 roe deer (*C. capreolus*), 190 red deer (*C. elaphus*), 379 wild boar (*S. scrofa*). Also general data (species, sex, age classes) together with biometric measurements and geographical data were recorded for each animal for spatial analysis assessment. A preliminary visual analysis was performed by classifying samples of wildlife according to altitude. Five classes were created: class I includes all samples found at altitudes above 500 m a.s.l., class II samples between 500–999 m a.s.l, class III samples between 1000–1499 m a.s.l, class IV samples between 1500–1999 m a.s.l, class V samples above 2000 m a.s.l.

The analysis was performed at the laboratory of food radioactivity of the Vercelli's Istituto Zooprofilattico Sperimentale del Piemonte, Liguria e Valle d'Aosta (IZS PLV). The tests, carried out on muscle samples was performed using "Packard COBRA" gamma counter mod. 5003 featuring a 3 inches NaI detector equipped with a read window for ^{137}Cs in the 580–754 keV energy range, and count time up to 180 minutes.

The results showed a significant difference of distribution of ^{137}Cs in four test species:

Chamois: min 0.0 Bq/kg, max 603.0 Bq/kg, mean 89.88 Bq/kg, 95% CI 64.24–115.52 Bq/kg

Roe deer: min 0.0 Bq/kg, max 986.0 Bq/kg, mean 90.80 Bq/kg, 95% CI 38.74–112.85 Bq/kg

Red deer: min 0.0 Bq/kg, max 166.0 Bq/kg, mean 20.52 Bq/kg, 95% CI 15.24–25.80 Bq/kg

Wild boar: min 0.0 Bq/kg, max 6199.0 Bq/kg, mean 472.81 Bq/kg, 95% CI 377.56–568.05 Bq/kg.

Data show ^{137}Cs higher levels in the chamois muscle tissue compared to those recorded in other studies. Furthermore ^{137}Cs data recorded in chamois, roe deer and wild boar showed levels higher than 600 Bq/kg which is the European legislation threshold for food. The presence of the radionuclide in the sampled subjects was not influenced by gender or age group. This result suggests that the exposure depends on heterogeneous environmental contamination and not on the different behaviour in the territory among subjects with different sex and age.

Regarding the altitude analysis, wildlife samples for all species collected above the altitude of 1000 m a.s.l turned to be more at risk than those collected under 1000 m a.s.l. in acknowledgement of the radionuclide presence in Alpine areas.

The present study still confirms Verbania province as a contaminated area for ^{137}Cs, showing levels overcoming those recorded in other European areas concerning wild ungulates. It also highlights the heterogeneous distribution of the radionuclide. A key step will be how to evaluate the use of this data, which represent a cost-effective tool. The actual limitations are related to the voluntary field sampling, as an integration to those which are carried out by official monitoring programs in order to learn more about environmental radioactivity of ^{137}Cs in natural ecosystems in a prevention perspective.

X Congresso Italiano di Teriologia

Effects of interspecies interactions: increased hormonal stress response of Apennine chamois (*Rupicapra pyrenaica ornata*) induced by livestock and red deer (*Cervus elaphus*)

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Interspecies interactions among ungulates may lead to competition because of an overlap of their habitat and food resources. Moreover interactions among potential competitors may cause a lower density or even the complete displacement of one competitor from its preferred habitats. This issue increases in case of overlap between wild and domestic ungulates: human presence related to livestock may indeed disturb and affect wildlife. Animals can face these adverse situations stimulating their endocrine system to produce glucocorticoids (stress responses). These hormones have an adaptive value and can provoke rapid physiological and behavioural adjustments that lead animals to react more efficiently to adverse circumstances. However, if stress persists may lead to a chronic stress state that can play a serious role in populations' decline. This concern has even major conservation importance when endangered species, such as Apennine chamois (*Rupicapra pyrenaica ornata*), are involved. Therefore, we used a non-invasive method to retrospectively evaluate the physiological stress response of Apennine chamois induced by the overlap between this species and red deer (*Cervus elaphus*) and livestock. In particular, we investigated (i) the effects of these interspecies interactions on chamois and (ii) if they could affect the health status of this endangered species.

Overall 318 chamois fresh faeces were sampled in three Italian National Parks: Abruzzo Lazio Molise (ALMNP), Majella (MNP) and Gran Sasso Monti della Laga (GSMLNP). In ALMNP and MNP three sampling macro-areas were identified (just chamois (C); overlap between chamois and red deer (CR); overlap between chamois and livestock, cattle and small ruminants (CL); in GSMLNP samples were gathered in areas C and CL. In the three parks sampling was conducted in September 2012 and July 2013; in ALMNP a further sampling was added in November 2012. Concentrations of faecal cortisol metabolites (FCM) were determined by an enzyme immunoassay (EIA) and data were analysed through Generalized Linear Models.

FCM concentrations of Apennine chamois were significantly influenced by the overlap between this species and livestock and red deer. FCM values registered in CL areas of ALMNP (both September 2012 and July 2013) and MNP (September 2012) were significantly higher than those recorded in C and CR areas. In MNP (July 2013), FCM concentrations of CR area were significantly higher than those of C and CL areas and FCM values of CL area were significantly higher than those of the C one. In GSMLNP (July 2013), FCM values registered in CL areas were significantly higher than those recorded in C area. Concerning the sampling months of ALMNP, in September and July FCM values of CL area were higher than those registered in November. In CR area FCM concentrations of July were higher than those of September and November. In both September and July, FCM values of CL area were higher than those of C and CR areas of the same sampling month.

Our results support that the overlap between Apennine chamois and both livestock and red deer may affect this endangered species. The higher FCM values of CL areas in ALMNP and MNP (September 2012) and in ALMNP and GSMLNP (July 2013) suggest a stressful condition of chamois induced by livestock. Moreover, human disturbance and the presence of shepherd dogs related to livestock grazing should be considered as further potential stressors for chamois. Conversely in MNP (July 2013), although FCM concentrations of CL area were higher than those of the C ones, the high FCM concentrations of CR area highlighted the negative effect of red deer on chamois. This fact could emerge in July since during summer red deer may extend its home range reaching chamois' habitat altitude. This finding could be supported by the increase of FCM of CR area in ALMNP during July 2013. Besides, these results are confirmed by FCM of ALMNP during November 2012: lower hormone concentrations were registered in these areas since during November livestock was not present and red deer lived at a lower altitude.

The presence of livestock and red deer appears to induce stress in Apennine chamois and these interspecies interactions could contribute to the populations' decline of this endangered species. However, the fact that the effect of red deer on chamois emerged only in July in MNP and, partly, in ALMNP leads to an in-depth analysis. Conversely the results highlighted in CL areas of the three parks should be considered in the management and regulation of livestock grazing and of the related anthropogenic factors within parks.

X Congresso Italiano di Teriologia

Measurement of faecal glucocorticoid metabolite levels in Eurasian red squirrels (*Sciurus vulgaris*): effects of captivity, sex, reproductive condition, and season

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The causes and consequences of physiological stress in wildlife is of great interest to workers in a wide range of biological disciplines. Measures of steroid stress hormones (glucocorticoids) are commonly used to quantify physiological stress. Recently, the measurement of glucocorticoid metabolites in faecal samples has become widespread. These assays require careful validation to show that endogenous changes in glucocorticoids are reflected in the faeces. We validate an enzyme-immunoassay to measure faecal glucocorticoid metabolite (FGM) concentrations in Eurasian red squirrels (*Sciurus vulgaris*). We biologically validate this assay by using temporary capture protocol to induce stress. We captured free-living squirrels (6 females, 11 males) and placed them into captivity for 48 hours. We show that FGM concentrations in female and male squirrels were significantly higher 24 and 32 hours after initial captivity with a lag time to peak excretion ranging from 24–36 hrs. We also measured FGM concentrations in free-living squirrels (37 females, 45 males) over a three year period during the summer, autumn, and winter months. Lactating free-living squirrels had the highest FGM concentrations compared to non-breeding or pregnant squirrels but there were no differences in FGM concentrations in males with scrotal and abdominal testes. Free-living squirrels had the highest FGM concentrations in the winter and lowest in the summer (summer<autumn<winter). Squirrels kept in captivity for 4–48 hours had significantly higher FGM concentrations than free-living squirrels (111 faecal samples from 82 squirrels). FGM concentrations in captive but not wild squirrels were significantly repeatable. We found no sex differences and no association with body mass in FGM concentrations in captive or free-living squirrels. Our results indicate that this assay can accurately quantify variation in physiological stress in Eurasian red squirrels.

X Congresso Italiano di Teriologia

Age and sex related differences in endoparasite burdens in a colony of Alpine ibex (*Capra ibex*)

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Many studies demonstrated that there is high variation in parasitism rates among hosts in natural conditions. This variability is associated with heterogeneities in the host population, and age and sex are two of the main factors generating these patterns. Alpine ibex (*Capra ibex*) live most of the year in sexually segregated groups, and it has been reported that genders have strong differences in abomasal helminthic community abundances, with males harbouring a total burden up to twice that of females. Few or incomplete information are available on distribution patterns among hosts of other gastro-intestinal and broncho-pulmonary parasites. Data collected during a 3-years survey on endoparasite dynamics in the colony of Alpine ibex of the Marmolada massif, in the eastern Italian Alps, were used to assess differences in parasite prevalence and abundance between males and females and between kids and adults.

A total amount of 356 faecal samples were collected monthly during the period of accessibility (June-November) from 2013 to 2015 in the study area. Faecal samples were collected from the ground. Samples were assigned to kid age class (<1 year old) either to adult age class ($\geqslant$1 year), based on obvious differences in faecal pellets' size. Gender was assigned only when it was possible to reliably associate the sample to an adult female or to an adult male. Quali-quantitative analyses for gastro-intestinal parasites (Coccidia oocysts; strongyles, *Nematodirus*/*Marshallagia*, Cestoda, *Trichuris* and *Capillaria* eggs) and broncho-pulmonary nematodes (larvae) were implemented. Different genera of lungworms were identified based on the linear lengths and the morphology of the tail. Differences in parasite prevalence and abundance values among considered groups were evaluated using respectively the Pearson Chi-squared test and the Mann-Whitney U test. Kids (n=41) were compared only with adults (n=223) living in the same areas (mostly females and undetermined yearlings, because of segregation of adult males). Adult females (n=157) were compared with adult males (n=106), excluding samples possibly belonging to yearlings.

Among the 356 collected samples, all (100%) were positive for Coccidia, 352 (99%) for strongyles, 265 (74%) for *Nematodirus*/*Marshallagia* and 74 (21%) for Cestoda. *Trichuris* and *Capillaria* eggs were sporadically found in faecal samples, respectively nine times and once. Concerning lungworms, 258 samples (72%) resulted positive for larvae of the genus *Muellerius* and 36 (10%) for *Protostrongylus*, whereas *Neostrongylus* and *Cystocaulus* were found in few samples, 11 and 2 respectively. Statistically significant differences in prevalence values between age classes were identified only for lungworms, with adults (77%) more infested than kids (32%) for *Muellerius* (p<0.001) and, on the contrary, kids (63%) more infested than adults (3%) for *Protostrongylus* (p<0.001). Prevalence values were not statistically different between males and females for all investigated parasites. Abundance values (overall average output of specific parasitic stages in faeces) also showed significant differences among considered groups. Kids had higher output of Coccidia oocysts (p<0.001) and *Protostrongylus* larvae (p<0.001), whereas adults were found with greater outputs of strongyles eggs (p=0.018) and *Muellerius* (p<0.001). Females showed a slightly higher output of Coccidia (p=0.033). The larval output of *Muellerius* tends to be higher in males (p=0.052).

The results of the study showed different patterns in age-related prevalence and abundance of the considered groups of parasites. Strongyles and *Muellerius* burdens seem to increase with host age, probably due to increased exposure to parasite infective stages. On the contrary, Coccidia and *Protostrongylus* loads are high in young animals and decline in adults. Acquired immunity and age-dependent changes in exposure to parasites are among the different mechanisms that might account for this decline. Females and males showed very similar values for most of the parasites. The only significant difference was found for Coccidia, with higher oocysts outputs in females, which may be due to their living side by side with kids. The expected higher burden of strongyles in adult males was not confirmed by our study.

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Alpine ibex (*Capra ibex*) versus *Sarcoptes scabiei*: field evidence of possible resistance as a driver for management and research

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C312

Along the years 2000–2002, 30 alpine ibexes (15 males and 15 females) coming from the Parco Regionale delle Alpi Marittime (Western Italian Alps, Cuneo province, Italy) were re-introduced in the Pale di San Martino dolomitic mountain massif (Parco Naturale Paneveggio – Pale di San Martino, Trento province, Italy), in order to found a new viable ibex colony. Along the following five years, this new colony progressively increased its consistency, reaching in spring 2007 the number of 55–60 subjects until, in the same year, the index case of sarcoptic mange was observed in ibex, as well as in the sympatric alpine chamois (*Rupicapra r. rupicapra*) population.

In less than a year, (July 2007 – April 2008), *Sarcoptes scabiei* almost wiped out the colony, causing a 75% mortality and lowering its size under the minimum viable population threshold. Therefore, to avoid possible extinction, a restocking was performed in 2010–2013, by releasing 14 ibexes (7 males and 7 females) coming from the dolomitic Marmarole colony (Belluno province, Italy). This choice was based on the empirical assumption that, since this colony had been already affected by sarcoptic mange and, what is more, with a moderate mortality, a kind of "resistance" to the disease was possibly driven by its individuals. The same assumption, moreover, had already been the basis of a previous operation, conducted by the Belluno Province for the restocking of the Marmolada-Monzoni (Belluno and Trento provinces, Italy) ibex colony with individuals from the Jof Fuart-Montasio (Udine province, Italy) colony in 2006–2007.

As well as the Marmolada-Monzoni, after the restocking also the Pale di San Martino ibex colony restarted growing, reaching in autumn 2014 the number of 40 individuals and, furthermore, showing from spring 2008 until now no mange cases, despite the still ongoing epizootic in sympatric chamois.

Under a conservation and management point of view, the evidences cited above are probably enough to recommend the use of individuals from previously exposed ibex colonies in case of population restocking after dramatic epizootics of sarcoptic mange. At the same time, while certainly the study of possible resistance to *S. scabiei* on a genetic-immunological basis is further encouraged by field expertise, in a research perspective it remains very difficult to disentangle the different factors that could influence or determine the mange impact on the Alpine ibex populations. Actually, one of the most evident source of uncertainty regarding the genetic resistance hypothesis is represented by the fact that even colonies showing spontaneous migration from each other can be affected by sarcopic mange to a significantly different degree. By now, a reduced variability at MHC class II loci has been described in other species and subspecies of ibex, and only two allelic variants have been observed in Alpine ibex. Collecting further information on these loci, together with data on neutral genetic markers, is therefore fundamental to estimate the adaptive potential of these populations and, in perspective, plan management activities also taking genetics into account. Moreover, the resistance hypothesis should be flanked by other investigations concerning, as an example, the ecology of *S. scabiei* at the ibex-chamois interface, the direct and interaction between these host species and the pathogen virulence.

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Gastro-intestinal helminth community of *Lepus europaeus* in Bologna province (Emilia-Romagna region): biodiversity drop in declining populations?

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C241

Since the Seventies, a continual reduction of the European brown hare population (*Lepus europaeus*) has been observed in most European Countries, including Italy. In the Bologna Province, Emilia Romagna Region, after a recovery phase a sudden acceleration of the hare population decline was noticeable from 2008: the hare captured in protected areas for restocking dropped from about 7000 in 2007–'08 to 1891 in 2014–'15.

In 2013, from September 15th to October 5th, 53 hares hunted in agro-ecosystems of the Po Plain (Province of Bologna, ATC BO2) were collected for parasitological analysis. All the helminths were collected from the stomach and the intestine using standard parasitological techniques, preserved in 70% ethyl alcohol and 5% glycerin and microscopically identified following clarification with 20% lactophenol. The sex of each hare and the weight of 52 of them were recorded by hunters; age class was assigned to 51 hare out of 53 by observing Stroh's tubercle. The animals examined were 40% adults and 60% juveniles, 57% females and 43% males. Mean weight was 3.4 kg (range: 2.1–4.5 kg). Only one helminth species was collected, i.e. the nematode *Trichostrongylus retortaeformis*. Thirty-eight out of 53 hare hosted *T. retortaeformis* (prevalence 72%); the mean parasite abundance was 22 helminth/examined-hare. Parasite prevalence was significantly higher in adults (95%) than in juveniles (54.8%) (Fisher exact test, $p<0.01$). Parasite abundance was significantly higher in adults and in heavier animals (multiple negative binomial regression with sex, age and weight as independent variables, $p<0.05$); parasites were significantly aggregated, with overall estimated $k=0.29$. None of the other gastro-intestinal helminth species commonly reported in hare (both nematodes and cestodes) were observed.

T. retortaeformis is the most common helminth of European brown hare. Several authors reported high prevalence of this parasite in Europe (50–91.7%). A prevalence of 92% had been reported about 20 years ago in the Bologna Province, but the helminth community, although dominated by *T. retortaeformis*, was characterized by a certain grade of biodiversity with an overall richness of 4 helminth species (3 nematoda and 1 cestoda).

Some authors report that severely *T. retortaeformis* infected animals can undertake chronic enteritis, mortality or body weight loss. In our case, the abundance of the infection is relatively low and it positively correlates to both the animal weight and age, suggesting no evident effect on parasitized individuals. In addition, the aggregation of parasites suggests that only a minimal part of host population would, if ever, be influenced by this infection.

T. retortaeformis infection has been also proposed as a possible causal agent of the cyclic population dynamics of *L. timidus* possibly mediated by the reduction in the body condition and fertility of the infected hosts. Although parasites can cause cyclical fluctuations in host populations (mediated by sub-lethal effects), they did not appear involved in long-lasting decline in hare populations.

A positive relationship between host density and parasite abundance is consistent with both theoretical and some empirical studies. The situation observed in our study area, and in particular low parasite abundance, is consistent with the low host density, that probably makes parasite transmission more difficult; in addition, the intense hare population turn-over, due also to seasonal hunting, make it difficult for parasites to gain high abundance due to the lack of older and heavy hosts. The absence of other usually observed parasite species is probably due to their lower ability to infect hosts if compared with the "well-adapted" *T. retortaeformis*, usually dominant in hare parasite community.

In conclusion, the critical situation of host population parallels with the loss of biodiversity observed in parasite community. This could eventually induce a harmful loop, since biodiversity is considered a stabilizing factor in ecological webs and the lack of specific brown hare parasites in biocoenosis may be a predisposing factor for the occurrence of exogenous and potentially dangerous parasite *taxa* in the hare population. The present study suggests that nor *T. retortaeformis* or other gastro-intestinal helminths were involved in the recent hare population decline (although it is not possible to ascertain that they are, or were, not involved in natural cyclic population dynamics). However, parasite community has probably suffered, directly (environmental mechanisms acting on both host and parasites) or indirectly (mechanisms acting on host density and therefore on parasite transmission), the same unknown cause of brown hare decline.

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An epidemiological model for the European brown hare syndrome (EBHS)

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C400

In the last decades a progressive decline in the hare populations has occurred in Italy and Europe generally. It has been associated, among the other hypothetical causes, also with the occurrence of European brown hare syndrome (EBHS), a highly contagious disease, emerged in the '80s and nowadays considered endemic in all European countries. EBHSV infection can achieve almost 100% morbidity, when it is introduced into a naive brown hare population and the mortality can be about 50–70% in the adult age class. The disease is not observed in young hares (less than about 2-3 months) that are infected without exhibiting any clinical sign and develop a long-lasting immunity usually characterized by low-medium antibody titers when compared to high titers shown by convalescent hares which survived to the disease.

In order to gain new insights on the disease epidemiology in brown hare population, we developed a mathematical model trying to describe the EBHS infection dynamics in an age-structured population. The model aims in particular at understanding the influence of hare population density in the EBHS epidemiology. In a previous described EBHS model density values greater than 15 hares/km^2 have been considered necessary to promote an endemic situation.

Our epidemiological model takes into consideration both hare biology and population structure, as well as the EBHS infection dynamics. The system is described by a compartmental model, where individuals are classified into different age categories (new born=<3 months, young=3–6 months and adult=>6 months) and stages of infection (susceptible/seronegative, infected and recovered/seropositive). The fluxes between different compartments are described by rate functions representing the development, the infection and the recovery. Natural mortality and well as mortality due to EBHS are also considered. The whole system is described by a set of eight ordinary differential equations.

The parameters in the demographic rate functions have been estimated from data reported in the literature and from own observations, the same is for the recovery rate.

Numerical tools allow us to investigate prevalence of overt disease and its impact (mortality and morbidity) during an EBHS outbreak. The model has been used to investigate possible disease epidemic scenarios. In detail, if the virus has an epidemic behavior into the hare population, the infection dynamic could be characterized by possible recurrent outbreaks with high mortalities. These outbreaks begin when the population immunity is low (high number of susceptible/seronegative individuals) and susceptible/seronegative young and adult hares are exposed to EBHS virus. As a consequence of EBHS outbreaks, surviving young and adult hares will develop protective immunity against the virus (i.e. seropositive).

In addition we consider the case in which there is a constant recruitment of a sufficient number of new receptive/seronegative individuals (represented by newborn hares): here the virus is maintained endemically with low mortality rate due to EBHS and most adult individuals become recovered/seropositive.

Future studies are needed to compare the obtained data with field ones, this modelling approach providing a new strategy for evaluation of the influence of population density and landscape characteristics on EBHS seroprevalence.

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Respiratory viruses in Alpine chamois in the western Italian Alps

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C357

In the heterogeneous ecosystem of the Alps an interdisciplinary approach is necessary to prevent, survey and control wildlife diseases to ensure the biological conservation. In this context the livestock-wildlife interface is of particular importance due to the presence of grazing livestock and the increase of wild ruminant populations with a possible spill-over of infections from livestock or vice versa, with risk of outbreaks. In particular, demographic decreases due to severe respiratory epidemic disease have been already reported in chamois. With the aim of monitoring livestock respiratory infections in chamois, sera (n=394) were collected from culled animals in two different hunting districts of Northern Italy: Verbania province (VCO2 – Ossola Nord) in 2007–2014 and Vercelli province (VC1 – Valle del Sesia) in 2013–2014. Sera were analyzed by virus-neutralization test to detect antibodies against Bovine Respiratory Syncytial virus (BRSV) and Bovine Viral Diarrhea virus (BVDV). Moreover, lungs (n=59) of yearlings and adults with macroscopic lesions, other than verminous pneumonia, were selected for sampling in 2012–2014 and were analyzed for virus presence by tissue culture isolation. In VCO2, due to a previous report of Mammalian Orthoreovirus (MRV) in lungs of chamois in 2009, serology for MRV and molecular characterization of S1 gene of the MRV strains detected were also performed.
BRSV seropositivities were observed in both study areas in yearlings and adults during all the period of analysis, with seroprevalence values ranging from 19.44% (C.I. 95% 6.65–32.24) to 77.14% (C.I.95% 63.40–90.89). Seroprevalence of BVDV was very low in both areas, with values always below 10%, except for 21.43% (C.I. 95% 6.36–36.50) observed only in 2012 in VCO2. Lung tissues showed macroscopic lesions (interstitial pneumonia in 12/22 samples) in VCO2 area in 2014 and one lung sample showed viral growth in cell culture. BVDV, BRSV and MRV have been excluded and further investigations are in progress to identify the causative virus. Concerning MRV, high seroprevalences were observed in VCO2, with values ranging from 42.11% (C.I.95% 20.04–64.17) to 75% (C.I.95% 50.59–99.41). A MRV type 3 was identified in lungs collected in 2009 and phylogenetic analysis showed a close relation among Italian sequences obtained from chamois, dogs and bats, extending the knowledge of MRV epidemiology.
On the whole, BRSV and MRV seroprevalence suggest that infections are endemic in chamois and seropositivities of yearlings along all the years suggest a continue re-infection of virus from chamois and/or by spill-over from other host species. Conversely, BVDV infection can be considered sporadic and it is likely a spill-over from livestock. Indeed, BVDV results are indicative of no maintenance of infection in chamois, also because female chamois are not pregnant during livestock spatial interaction and therefore it is unlikely that vertical transmission of infection can occur.

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Wild rodents as reservoirs of tick-borne diseases in the Abruzzo region

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C272

The maintenance of zoonotic diseases in the environment depends on complex eco-epidemiological cycles that involve several abiotic and biotic factors, including vertebrate and invertebrate vectors and reservoirs. The knowledge of such complex cycles is the first critical step to define effective prevention programs, especially in rural or natural areas with a strong touristic vocation.
We aimed to investigate the role of wild rodents in the maintenance and circulation of four pathogens causing tick-borne diseases (Lyme disease, Rickettsiosis, Q fever, human granulocytic anaplasmosis) in the Abruzzo region, an area where these diseases have been sporadically reported with cases of human and animal infection but where their eco-epidemiologic cycles are still poorly known, especially with respect to species, geno-species, tick vectors and vertebrate reservoirs.
We used Sherman live traps to capture wild rodents in 21 forested sites from July 2014 to November 2015. Each captured rodent was sedated and a small sample of blood was collected from the mandibular plexus. Rodents were also inspected for feeding ticks that were collected and stored in 70% ethanol. After the procedures animals were released at capture sites. In a subsample of 8 sites we also used the "dragging" method to collect free-living ticks in order to compare the circulation of pathogens between rodents and the rest of the environment.
Collected ticks were identified at the species or genus level by using stereomicroscope or by sequencing of *12S* rRNA. Blood and tick DNA was extracted and tested for the presence of the four selected tick-borne pathogens (*Borrelia burgdorferi* s.l., *Rickettsia* sp., *Coxiella burnetii*, *Anaplasma phagocytophilum*) by means of Real Time PCR with specific primers and probes. DNA sequencing was also carried out on positive samples to identify pathogens at the species or geno-species level.
We collected and analyzed 112 blood samples belonging to 80 *Apodemus flavicollis*, 7 *A. sylvaticus*, 22 *Myodes glareolus*, 3 *Eliomys quercinus*. We found positive samples for *B. burgdorferi* s.l. and for *Rickettsia* sp.. On rodents we collected 315 feeding ticks (mainly *Ixodes* sp.) and found positive samples for *B. afzelii* and for *R. raoulti*/*R. slovaca*. Finally, out of the 210 free-living ticks collected (mainly *Ixodes* sp.), we found positive samples for *B. valaisiana*, *B. garinii*, *B. afzelii*, and for *R. monacensis* and *R. slovaca*. We did not find any positive blood or tick samples for *C. burnetii* and *A. phagocytophilum*.
Our results highlight the role of wild rodents in maintaining in the area some of the etiological agents of Lyme disease and Rickettsiosis. In particular, *B. afzelii* geno-species, that is associated to rodents but pathogenic for humans, is likely maintained and amplified by the specialist tick *I. acuminatus* at the level of rodents. The implications of our findings are discussed.

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An epizootiological survey of bats as reservoirs of emerging zoonotic viruses in Italy: implications for public health and biological conservation

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C404

Bats are being increasingly recognized as the reservoir of highly pathogenic and zoonotic emerging viruses in tropical regions, however, little is known on the human-pathogenic viruses, which may be present in bats in European countries. Considering the poor eco-epidemiological data on the circulation of viruses in bats in Italy, in 2014 the Italian Ministry of Health funded a project entitled "*An epizootiological survey of bats as reservoirs of emerging zoonotic viruses in italy: implications for public health and biological conservation*" with the leadership of the Istituto Zooprofilattico Sperimentale della Lombardia e dell'Emilia Romagna and involving both the University of Bari and the Reference Centre for Rabies and for Infectious Diseases at the Animal-Human Interface based at Istituto Zooprofilattico Sperimentale delle Venezie, Italy.

This project aims to cover both human health and biological conservation issues by promoting and implementing a passive and active surveillance system for viral infections in Italian bat populations. The survey is mainly targeted on the detection of coronaviruses, lyssaviruses and orthoreoviruses; of notice, diagnostic protocols broadly targeting viral pathogens will also be implemented, to investigate other newly-emerging viruses with a potential zoonotic importance or proving dangerous for bats. We are herewith describing the activities performed so far within the framework of the first year of the project and presenting the overall data on the virological load in Italian bat populations obtained from our previous investigations in bats, which have been crucial to provide valid background results for a credible project proposal in the fields of viral zoonoses, veterinary virology and chiroptera conservation.

Passive surveillance involved the analyses of dead animals collected from bat rehabilitation centers or from known roost sites. Fresh carcasses were fully necropsied, and tissue specimens from different organs were analyzed. Fecal samples collected from injured and hospitalized individuals were also sampled and tested. Organs and fecal samples were examined through a broadly reactive PCR-based protocol for the presence of viral agents with zoonotic potential. Next generation sequencing (NGS), virus isolation techniques and electron microscopy were also used. Active surveillance involved live sampling of free-ranging animals from selected colonies. Bats were captured with hand nets and samples were collected under physical restraint, including blood, salivary swabs, feces/anal swabs, and wing biopsies. Serum samples were analyzed for the presence of antibodies against European bat lyssavirus 1 (EBLV1), while molecular biology was applied to saliva and fecal material to investigate the presence of lyssaviruses, coronaviruses and orthoreoviruses.

A diagnostic protocol for investigating the major viral infections of bats was developed and applied on field samples originating from different parts of Italy. A total of 580 fecal and tissue samples belonging to 12 different bat species (*Pipistrellus kuhlii*, *Hypsugo savi*, *Pipistrellus pipistrellus*, *Nyctalus noctula*, *Rhinolophus hipposideros*, *Tadarida teniotis*, *Vespertilio murinus*, *Plecotus auritus*, *Miniopterus schreibersii*, *Myotis blythii*, *Myotis myotis*, *Eptesicus serotinus*) were analysed between 2009–2015.

We demonstrated that coronaviruses, both AlphaCoVs and BetaCoVs, are widespread among Italian bat populations. The whole-genome sequence of two strains belonging to the clade 2c betacoronavirus related to MERSC-CoV was obtained and characterized. Bat lyssavirus infection has been detected in *Myotis myotis* and *Myotis blythii* during the active surveillance in two mixed colonies, the results will be presented by Leopardi et al., in the course of this same congress.

The survey also provides evidence that insectivorous bats carry a wide variety of Mammalian orthoreoviruses (MRVs) with members of the type 3 mostly represented. Three representative MRVs belonging to serotype 1, 2 and 3 were selected and fully-sequenced through NGS. In particular, BatMRV3-5515/2/IT2012 showed the highest similarity (99%) with a virus (SL-MRV01) recently detected from a child with acute gastroenteritis in Slovenia and its zoonotic potential deserves further investigation. Positivity for astroviruses and adenoviruses were also detected in fecal and organ samples. respectively.

Results offer a preliminary dataset on the distribution of major viral infections in bats in Italy, an achievement so far never obtained, which improves our understanding on their spread and evolution. The project also proves to have enhanced the methods for detecting the viruses that may emerge from bats and has strengthened the cooperation between human and veterinary virologists and bat specialists.

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X Congresso Italiano di Teriologia

Pathogens at the bat-human interface: evaluating european bat Lyssavirus circulation in Italy

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C405

An impressive diversity of viruses is increasingly reported in bats worldwide, fueling the idea of these animals as being crucial reservoir for emerging infectious diseases. While the phylogenetic proximity of some bat viruses with human pathogens suggests their possible relevance in public health, others form a monophyletic clade in bats, sometimes strongly divergent from known viruses. These are mostly relevant in terms of pathogen discovery, while their ecological, pathological and epidemiological value still needs to be assessed. This progressive uncovering of bats' virome was triggered by the significant increase of samples collection started after the concomitant report in 2005 of Ebola and SARS-like viruses in bats from central Africa and China. Since then, bats have been implicated in the emergence of many other human infectious diseases, including Nipah, Hendra, Marburg and Middle East Respiratory Syndrome (MERS), supporting the risk for public health associated with these animals. The implementation of an efficient passive surveillance system is a priority in terms of continuous monitoring of possible emerging pathogens from bats. However, this approach is very limited for estimating basic epidemiological information such as virus prevalence, shedding and transmission patterns. In this context, the integration with data from longitudinal monitoring of positive colonies (active surveillance) might be more appropriate. We are herewith presenting the results from the active surveillance of greater *Myotis* bats.

Active surveillance involves live sampling of free-ranging animals. For the first season, we focused our attention on two colonies where circulation of coronaviruses and lyssaviruses was previously reported. They were both located in a church's roof near Bolzano and included a mixed population of *Myotis myotis* and *Myotis blythii*. Bats were captured with hand nets and samples were collected under physical restraint, including blood, saliva swabs, and feces. Serum samples were analyzed for the presence of antibodies against European bat lyssavirus 1-2 (EBLV1-2), while molecular biology was applied to saliva and feces to investigate the presence of lyssaviruses, coronaviruses and mammalian orthoreoviruses (MRV). Fresh carcasses found in the colony were also collected and analyzed.

We were able to confirm circulation of all target viruses in *Myotis* bats from Northern Italy trough active surveillance. In particular, we estimated seroprevalence for lyssavirus of 5–17% in *Myotis myotis* and of 15% in *Myotis blythii*, while the absence of detectable lyssavirus RNA from saliva swabs suggests a viral shedding lower than 5%. No lyssavirus infection was identified in 5 brain samples collected from bat carcasses. As for other relevant viruses, we detected a viral prevalence of 5% for coronavirus in *Myotis myotis* and of 15% for MRV in *Myotis blythii*. Further analyses are ongoing and carried out in collaboration with the Istituto Zooprofilattico Sperimentale della Lombardia e dell'Emilia Romagna (IZLER) to characterize MRV's serotype. Continuous monitoring of these colonies in the following years will be essential to investigate the ecology of viral infection in bats. In particular, we are willing to evaluate the role of bats as reservoir for these viruses through the study of viral persistence and transmission, and the influence of seasonality on disease dynamics.

Besides the evaluation of these parameters associated with the host and the pathogens, we are also considering human behavior as a driver for emergence, as it may enhance the risk associated with bat viruses by altering the likelihood for their spillover to humans. We consider the mitigation of human factors as a priority as it allows for a strong decrease of the risk with a minimum effort. Thus, under the framework of the project entitled "*An epizootiological survey of bats as reservoirs of emerging zoonotic viruses in Italy: implications for public health and biological conservation*", we have developed specific guidelines for a safe manipulation of bats, in order to reduce in bat workers the risk of exposure to potential pathogens. These guidelines also contain information on the submission of bat samples to the National Reference Centre for Rabies to be tested for the presence of rabies-related lyssaviruses. As the screening of animal brains is the gold standard for the diagnosis of lyssavirus infection, enhancing passive surveillance by increasing the final number of animal submitted is essential to clarify the epidemiological status of Italy for such a relevant pathogen with a direct zoonotic impact.

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Workshop: Mammiferi e Rete Natura 2000

La Direttiva Habitat (92/43/CEE) rappresenta un essenziale pilastro della politica comunitaria per la conservazione della natura garantendo, nel nostro Paese, la protezione di circa 350 specie di animali e vegetali e 132 habitat di importanza europea. Gli Stati Membri hanno l'obbligo di monitoraggio dello stato di conservazione di habitat e specie di importanza unionale e devono riportare alla Commissione Europea, ogni sei anni, i risultati di tali attività, attraverso un Rapporto contenente dati riguardanti i principali parametri relativi allo stato di conservazione di habitat e specie. Il monitoraggio dello stato di conservazione delle specie in Allegato II, IV e V della Direttiva Habitat, rappresenta un importante metodo di controllo relativo all'efficienza dei sistemi di gestione adottati per la conservazione delle specie e degli habitat di interesse unionale su scala nazionale e regionale, consentendo l'adempimento della valutazione periodica da parte della Commissione del contributo della Rete Natura 2000 alla conservazione della biodiversità. Attualmente sono avviate le attività che risulteranno preparatorie al 4° Rapporto (relativo al periodo 2013–2018), e in tale contesto l'ISPRA ha il compito di sviluppare un Piano di Monitoraggio, in collaborazione con le società scientifiche nazionali, tra le quali l'Associazione Teriologica Italiana per quanto riguarda i Mammiferi. Le liste ufficiali per l'Italia annoverano oltre 50 specie di Mammiferi di interesse europeo, il cui stato di conservazione deve essere valutato a livello nazionale e per regione biogeografica. I dati necessari alla valutazione comprendono: distribuzione, areale, consistenza delle popolazioni, andamenti distributivi e di consistenza, qualità e disponibilità dell'habitat, pressioni e minacce. Scopo del presente *workshop* sarà quello di favorire il dibattito in merito all'elaborazione di protocolli di monitoraggio *standard* per i Mammiferi di interesse unionale e valutare casi di potenziale inadeguatezza della Rete Natura 2000 per alcune specie, oltre che approfondire l'analisi in merito ai valori favorevoli di riferimento (VFR) richiesti dalla normativa europea.

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Venerdí 22 Aprile 2016

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Mammiferi: ecologia, evoluzione e comportamento

Il comportamento costituisce l'interfaccia attraverso la quale gli animali si relazionano con le componenti abiotiche e biotiche di un ecosistema e rappresenta perciò un elemento strettamente legato all'ecologia delle specie. La conservazione e la gestione dei Mammiferi richiedono una conoscenza approfondita sia dell'ecologia sia dell'etologia delle specie oggetto d'interesse.

In questa sessione si intende dare spazio a contributi che esplorino, a livello di singole specie e comunità, le relazioni con l'ambiente e gli aspetti comportamentali con la finalità di comprenderne il ruolo nell'ambito delle funzionalità ecosistemiche. Ci si riferisce sia a ecosistemi naturali sia a ecosistemi influenzati dall'azione umana.

Sono incoraggiati anche gli studi di nicchia ecologica e quelli riguardanti le interazioni tra specie che condividono lo stesso ambiente, nonché i contributi metodologici in ambito autoecologico e sinecologico, in un'ottica il più possibile rivolta alla comprensione dell'importanza di tali fenomeni in una prospettiva ecosistemica.

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X Congresso Italiano di Teriologia

The only good neighbour is a dead neighbour: the difficult coexistence amongst carnivores

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C329 Opening Lecture

"Niche" partitioning is necessary to allow the local coexistence of two or more species through the specialisation and reduction of their respective niche breadths. Yet, if the food spectrum is considered, its breadth should rather increase under competition because of the decreasing encounter rate with preferred food types, leading to an increased generalism.

Two basic types of competitive interactions may be recognised, *interference* and *resource exploitation*. Interference is any activity which either directly or indirectly limits a competitor's access to a necessary resource or requirement, whereas exploitation is the utilization of a resource once access to it has been achieved. Two coexisting species, especially if closely related, will have to evolve adequate strategies to avoid the negative effects of competitive interactions. By scanning the relevant literature and by considering examples from our own work, I have identified five main strategies: (A) using the same resources at different times; (B) using the same resources in different habitats; (C) using the same resources, at the same time, in the same habitat, but in different areas; (D) specialising on different food resources in the same habitat; (E) specialising on different food resources in different habitats.

(A)(B)(C) help mainly to avoid interference, while (D) helps mainly to avoid resource exploitation and (E) helps to avoid both interference and resource exploitation.

Amongst large mammals, carnivores tend to use interference for competitive interactions, whereas herbivores (ungulates) appear to prefer resource exploitation. In carnivores, smaller species are expected to develop ploys to reduce the risk of potentially lethal encounters with larger, dominant ones. In my talk, I will concentrate mainly on examples from our own work on threatened large cats: the tiger, the common leopard and the snow leopard.

X Congresso Italiano di Teriologia

Spatial ecology of wolves (*Canis lupus*) in a protected population in the central Apennines, Italy

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C370

Although the gray wolf (*Canis lupus*) is a comprehensively studied species, many aspects of its ecology originate from populations inhabiting pristine environments in North America and Scandinavia. Nevertheless, being a highly adaptable species, wolves proved to be the most successful amongst large carnivores in persisting in human-altered environments, where they adopt different spatio-temporal strategies to minimize contact with humans. In such conditions, however, accurate knowledge concerning spatio-temporal adaptations by wolves is lacking, and this is especially true for Italy where only one such study has been published so far, limited to one VHF-collared wolf. We hereby report on home ranges, core areas, space use interactions, extra-territorial movements and dispersal of wolves in the Abruzzo Lazio and Molise National Park (PNALM, Central Apennines), one of the most important historical stronghold of the species in Italy and where wolves have been surviving at close quarters with humans since millennia.

From 2006 to 2010, we live-trapped (modified Aldrich foot snares) and GPS-tracked (Televilt-Tellus and Vectronics Pro Light-1) 11 wolves in the PNALM. Using snow-tracking and wolf-howling we distinguished between wolves belonging to territorial packs, and non-territorial, lone wolves. Based on a GPS acquisition rate of 1 fix/3 hrs, we estimated home ranges of territorial wolves using the Brownian Bridge Movement Model (BBMM; `R` package `adehabitatHR`), which is particularly suited for highly autocorrelated GPS data. We hypothesized that home ranges would be influenced by both seasonal and diurnal effects. Accordingly, we estimated home ranges on a seasonal basis, accounting for shifts in wolf ecology and environmental changes (summer: May-September, early winter: October-December, late winter: January-April), and further compared diurnal vs nocturnal home ranges for each season. For descriptive reasons, we also calculated home ranges on an annual basis. To obtain individual-based and biologically more meaningful estimates of core areas within the home range, we used a time-maximizing function based on exponential regression models built using Utilization Distribution's (UD) area *vs.* volume values. We investigated spatial responses by wolves towards anthropogenic features by using road and settlement densities as proxies of human interference. We also measured the spatial overlap between home ranges of adjacent packs, and supplemented this information with a proximity analysis. Lastly, we described extraterritorial movements and dispersal in terms of frequency, duration and distances travelled by wolves.

We collected a total of 23085 GPS locations (283–3767 locations/wolf, and 45–581 tracking days/wolf), but we excluded from the analyses: (i) 3 wolves whose tracking period was not sufficient to estimate stable home ranges, and (ii) 2 non-territorial lone wolves. Our final dataset comprised 21816 GPS locations obtained from 6 territorial wolves (3 males, 3 females) in 5 packs. Annual home ranges (95% isopleth of the BBMM-defined UD) of resident packs averaged 80.5 ($\pm$29.8 SD) km^2, ranging 42.7–113.4 km^2. Accounting for a surface-area correction (3D Analyst Tools, ArcGIS) home ranges were on average 8–17% larger than their planar estimates. Road and settlement densities within wolf packs' home ranges were 32 km and 3 km^2/100 km^2, respectively, and did not differ from the corresponding values throughout the entire study area. We detected a seasonal variation in home range size, with summer home ranges on average 52.1% and 13.8% smaller compared to early winter and late winter home ranges, respectively. Depending on the season, core areas represented on average 15.5%–38.9% of the home range, but not all wolves displayed a core area. We also detected a circadian effect in home range size, with diurnal home ranges on average 25.1%–54.1%, smaller that nocturnal ones, depending on the season. Wolves restricted their summer home ranges in areas of lower settlement density (1.4$\pm$1.3 km^2/100 km^2) with respect to the other seasons (2.4$\pm$0.8 SD km^2/100 km^2). During summer, road density was 23.8% lower in diurnal with respect to nocturnal home ranges, whereas settlement density was lower in diurnal compared to nocturnal home ranges during both summer and late winter (86.1% and 56.6%, respectively). Annual home ranges of adjacent packs (n=2) scarcely overlapped (15.3%), with simultaneously tracked wolves separated by distances >1 km 98.8% of time; conversely, a one pair of wolves within the same pack were at distances <100 m in 70.6% of simultaneous fixes. Territorial wolves engaged in extraterritorial movements (n=27) on average once every 13 days, essentially during early or late winter, travelling minimum distances of 13.9 ($\pm$6.7 SD) km. Two wolves engaged in dispersal movements, one (9.7 km; January) corresponding to the establishment of a new territory adjacent to the natal one, and the other ($\geqslant$79.7 km; October-December) eastwards in the Majella National Park. Although limited, our data are the first that describe spatial organization by multiple packs in a source wolf population in Italy. Similar data are needed from less productive and more human-altered ecosystems to fully appreciate the spatiotemporal flexibility of wolves in highly populated countries such as Italy.

X Congresso Italiano di Teriologia

Behavioural patterns of the brown bear at rub trees in the Alps

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C264

The behaviour of rubbing on trees by bears is an action whereby the animal stands on its back limb and scratches itself on the bark, sometimes leaving visible marks with its claws or teeth. The trees chosen for rubbing are usually the same over time, are used by different individuals and can be usually recognizable from the surrounding environment often being in prominent locations along trails or forest roads. The rubbing behaviour is known to occur throughout the range of occurrence of the species of brown bear (*Ursus arctos*). Only relatively recently this habit have been recognised as a mean of intra-specific communication and not only as a way to remove ectoparasites. Field evidence from grizzlies in North America showed that rubbing leaves a scent mark on trees and that it is mainly performed by adult males during the breeding season; however, studies on this behaviour in Europe are lacking. Rub trees (around 150/year on average) have been continuously monitored in Trentino (Italian Alps) since 2009, in the framework of the genetic monitoring of the local bear population.

We used camera traps placed in front of 20 known rub trees in the central Italian Alps, during a three-year survey (2012–2014), to record videos of bears and other mammals, allowing us to assess behavioural patterns and classify bears according to age and sex classes. We collected more then 500 videos of bears through a sampling effort of about 9000 camera days. The bears have been classified according to age and/or sex classes in 59% of the videos, while the rest remained undetermined. Individual identification from camera trap images was difficult (only 12 individuals could be identified from a population of about 50 animals thanks to the presence of ear tags or GPS collars). Vehicles, cattle, people and 12 medium-large sized mammals were also detected, including the first record of wolf in the area and the only lynx known to be present in the area. The occurrence and behaviour of other medium-to-large mammals was used to verify the hypothesis that rub-trees may also play a role in inter-specific communication.

Results showed that adult males are the main performers of rubbing, matching evidence from studies in North America. Females and sub-adults occasionally marked the trees, while cubs almost never did. Rubbing was significantly more performed by males during the breeding season, confirming that this behaviour is mainly related to the mating strategy of the species. Rubbing was also observed during the non-breeding season but with much less intensity, and investigation of rub trees was performed by bears of all ages and sexes, confirming the importance on scent marking for intra specific communication for the species. The only tree female bears who rubbed the trees were recored in autumn, outside the breeding season. To determine if the marking of a tree by a bear triggered a response in individuals subsequently passing by the same rub tree, we recorded the type of behaviour, age/sex class and time lag of the next event after a bear rubbed. The output of this sorting was a set of two concatenated behaviours, in which the first event was always a rubbing (80% of the time by an adult male) and the second event (rubbing, investigate only, indifference) was recorded only if it happened within a lag of 30 days, after this time the second event was considered to be independent from the first. This analysis proved that marking a tree did trigger a reaction in another bear 62% of the times (either rubbing or investigation), and this proportion was significantly different from a random sample of events created for comparison. These results show that male brown bears use chemical communication during the breeding season to advertise their presence to possible rivals and to find a partner, while the function of rubbing outside the breeding season remains unclear although it could still serve to mark presence besides other functions such as ectoparasites removal.

X Congresso Italiano di Teriologia

The study of activity rhythms in wild mammals: opportunities to understand how animals deal with ecological and human constraints

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C415

Wild animals have to cope a complex trade-off between optimal foraging time, social activities and environmental constraints. In this framework activity rhythms are important in controlling the energy balance of a species, play an important role in the ecological relationships of a species and form part of its evolutionary adaptation. In the past, activity rhythms of wild large mammals were studied by direct observations or by means of VHF collars. The first methodology can be used only for species living in open areas and during the daylight hours. On the contrary, the analysis of the VHF signal, emitted by radio-collars, allows to study the behaviour on the 24 hours as it does not require a direct visual contact with the animals. Anyway, this methodology resulted to be very demanding, because it needs extensive data collection sections and returns a reduced number of data per hour. To date, thanks to GPS collars fitted with accelerometers, we can obtain highly detailed information on activity levels of wild animals with a limited effort.

In this talk, we show the opportunities provided by the analyses of activity sensors' data and the findings obtained for three ungulate species: Alpine chamois (*Rupicapra rupicapra*), wild boar (*Sus scrofa*) and Alpine ibex (*Capra ibex*) in different study areas in Europe. The collection of a large amount of high-frequency and high-detailed data allows to implement chrono-biology analyses that, up to now, have been mainly used for laboratory experiments. The first detailed field study of chamois activity showed that this species exhibited clear daily and annual activity rhythms entrained to the light-dark cycle. Chamois were more active during spring-summer and less active during winter, likely in response to the variation in the availability of food resources. Moreover, detailed information about locomotor activity provide the opportunity to fit accurate statistical models to assess the effects of biotic and abiotic factors on activity rhythms. Our results showed that chamois and wild boar are expected to oppositely modify their activity in response to global climate change. Finally, we studied the activity rhythms to investigate the effect of an impacting human activity, i.e. the capture and manipulation of living animals. We highlighted the impact of the captures on Alpine ibex and wild boar behaviour, but we also showed different responses between the two species. In conclusion, we elucidated some study opportunities provided by the analysis of activity rhythms in wild mammals. Our results on the current relationship between mammal activity and ecological constraints or human harassment may shed light on the animals' ability to cope with annual cyclic changes and to adapt to climate modifications.

X Congresso Italiano di Teriologia

Summer temperature influences movement and habitat use of Alpine ibex females

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C373

In summer, movement and habitat selection of heat-sensitive large herbivores, such as ibex, can be strongly influenced by thermoregulatory needs, possibly at the detriment of foraging. In addition, reproductive status may impose further constraints on lactating females. In this study, we investigated how temporal patterns of movement, elevation and habitat use were interrelated and influenced by temperature and reproductive status in female Alpine ibex in the Marmolada colony (North Eastern Italian Alps). We predicted that animals would use highest elevations and reduce movement and activity mostly during the day, and under stochastic heat stress. We verified whether this was associated with increased use of non-foraging habitats (rocks and scree), and decreased use of foraging habitats (grasslands and areas with sparse vegetation). We predicted that females with kids moved less than females without kids (according to movement limitation hypothesis), but wanted to verify whether this was compensated by higher activity and use of foraging habitats.

We analysed approximately 49000 GPS positions of 20 females (>2 years age) collected during summer (weeks 23 to 40) from 2010 to 2015. We scheduled GPS Collars (VECTRONIC Aerospace GmbH, Berlin, Germany) to acquire 24 fixes/day. We also collected activity data with two-axis acceleration sensors, storing 5 min period-averaged data. Locations were spatially associated with elevation, slope, and habitat type, and temporally associated with individual activity (active/inactive), reproductive status (lactating or non-lactating), and daily average temperature. Step length was also derived from trajectories. We used general additive mixed models to model intra-seasonal (weeks) and diel patterns of step length variation, use of elevation, and use of forage habitats, in dependence on stochastic temperature (deviation from temporal trend of the period) and reproductive status. Similarly, we used general additive mixed models to model intra-seasonal (weeks) and diel patterns of activity patterns in dependence on stochastic temperature, reproductive status and use of forage habitat.

Females showed a clear circadian pattern in use of elevation, with maximum use of highest elevation in the central hours of day and minimum use from early night to dawn. This pattern was more marked in mid-summer, when temperatures were the highest, than at the beginning and the end of the season, and in dependence on stochastic variation of high temperatures. Also use of forage habitats followed a similar pattern, with a prevalent use in the early hours of the day, whereas non-forage habitats were used in the central hours of day and when stochastic temperatures were higher.

Consistently, females had shorter step lengths and a higher probability of being inactive during night, but also in the central hours of day when they were at the highest elevations.

Reproductive status of females affected step length and habitat use, with lactating females moving less, and using higher elevation and non-foraging habitats more than non-lactating females, but especially at the beginning of the season. Activity did not differ between females with and without kids.

These results confirmed our predictions that, in summer, Alpine ibex females move to higher elevations and reduce movement and activity during periods of heat stress. This was associated with a reduction in use of foraging habitats, which might suggest a trade-off between thermoregulation and foraging. The results supported the movement limitation hypothesis for lactating females, but only for a short period after birth, with modest differences afterwards. Possible mechanisms used by lactating females to compensate for their higher energy and protein requirements do not seem to involve marked changes in movement and habitat selection as in other, non gregarious, species.

X Congresso Italiano di Teriologia

Cows make the difference: livestock favour bat foraging activity in agropastoral landscapes

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C266

Grazing by free-ranging livestock heavily affects plant diversity of pastures, in turn influencing wildlife activity. Bats are multi-habitat specialists, that actively select different habitat types for roosting, commuting and foraging, and are thus highly sensitive to habitat modifications. There is evidence that non-intensive farming and especially the presence of cattle dung may favour some bat species by increasing prey availability. Besides, preliminary work conducted in the UK has suggested that the presence of cattle itself may favour bat foraging by attracting insects. In our study we assessed the separate effects of the presence of grazing cattle and dung on bat foraging activity in an agropastoral landscape of central Italy. We did acoustic surveys of bat activity in pastures under three conditions: i) pastures with grazing cows present at night, ii) pastures with fresh cattle dung but no cows present at night, and iii) control pastures with neither cows nor fresh dung. Both dung and cows increased foraging activity of bats with respect to control pastures, yet the presence of cows actually had a much stronger effect than that of dung alone. We also used thermo-imaging and actually observed bats foraging near cattle. However, the positive effect of cattle was only recorded for a range of small, ecologically flexible aerial hawkers that fly relatively close to the ground, while neither high-flying species nor those with specialized diet responded to the presence of grazing cows or cattle dung. Our results show that the presence of free-grazing livestock favours bat foraging in non-intensive farming landscapes.

X Congresso Italiano di Teriologia

Personality in Eurasian red squirrels (*Sciurus vulgaris*): does it pay to be bold?

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C316

Animal personality refers to between-individual differences in behaviour that persist through time. Personality is considered to be subject to natural selection, and measuring its fitness consequences is an important step in the study of the evolution of this phenomenon. Changing intrinsic (age, reproductive condition) and extrinsic factors (habitat quality, spatio-temporal variation in food availability) can affect the costs and benefits of personality traits and these evolutionary costs and benefits may also differ among the sexes. In mammals, still little is known about consequences of personality on survival or reproductive success, and existing evidence reveals varying effects in different species.

Here we measure for the first time personality traits in the Eurasian red squirrel (*Sciurus vulgaris*) and investigate to which extend boldness and exploration tendency are related to space use of adults. Next we explore potential advantages or disadvantages of differences in personality by studying whether indices of boldness and exploration are correlated with local survival in both sexes and with a measure of reproductive success in females. We used capture-mark-recapture data of individually marked squirrels to obtain data of phenotype (sex, body size and body mass), estimate local survival and female reproductive success. The total number of captures (trappability) and number of different traps where an individual has been captured (trap diversity) were used as indices of personality. Finally we used radio-tracking data to define space use patterns. A total of 93 red squirrels (52 males, 41 females) were captured between 1 and 87 times (median 7, mean$\pm$SE=12.0$\pm$1.4 captures), and an individual was trapped in 1 to 14 different traps (median 4, mean$\pm$SE=4.8$\pm$0.3 traps). Length of capture period was positively related to the number of captures and to trap diversity; thus personality scores were adjusted for the effect of capture period. Using a restricted samples of squirrels caught in two successive years, we observed significant and consistent individual differences across years in number of captures (repeatability=66%), and in visiting different traps (repeatability=69%). Thus, trappability (boldness) and trap diversity (exploration) indices are reliable estimates of a red squirrel's personality. In males, variation in survival was mainly affected by variation in body mass. However, also the propensity to explore the habitat had a positive effect on survival. Also local survival of females increased with their body mass, but only in one of the two study areas. Among females, there was a negative effect of propensity to explore on survival, but we found no effect of boldness score. Female reproductive success was not related to any of the personality scores, but strongly increased with body mass. We found no or only limited effects of personality on variation in space use: only for females both personality scores were positively related with residual variation in core-area size, suggesting that bold females with a stronger tendency to explore had larger core areas than shy individuals that explore less. The implications of these findings for maintaining variability in personality among squirrels will be discussed.

X Congresso Italiano di Teriologia

Forest ecosystem: does climate play a key role in producer-consumer dynamics? Wild boar and broadleaved forest in the Italian Apennine

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C365

A key feature in ecology is to understand the interaction between the several components of an ecosystem, and indeed, every part of the system can have a feedback on the others. For example, in forest ecology climate is fundamental for plant development and soil composition, but plants can modify climate and change microclimate. Plants often affect animals presence and dynamics, but animals in turn could determine plant reproductive success and dispersal. Many terrestrial ecosystems, and in particular forest ecosystems, are characterised by pulsed resource availability. Mast seeding is the intermittent and synchronous production of large seed crops and it is a well-known example of resource pulses that create lagged responses in the superior trophic levels of communities. In this context untangling consumer-producer dynamics becomes a challenging topic. Several studies demonstrated that mammal populations are strongly influenced by the spatial distribution of resources and the seasonal variation in food quality and availability. In the present research, a simplified ecosystem with broadleaved forest productivity and wild boar behaviour as main components has been investigated, considering possible influences of climate. In the next century the Mediterranean basin will be one of the regions most affected by climate change, and this could have consequences on forest productivity: indeed, masting in many plant species is driven by external factors such as climate variations, and this is the case for example of beech masting, which typically occurs after a year characterised by high summer temperature and low precipitation. We analysed a 23-years seed production series in the most common broadleaved species in the Apennine (*Fagus sylvatica* L., *Quercus cerris* L., *Castanea sativa* Mill.) to understand the role of climate in forest productivity. Moreover, information on wild boar behaviour has been collected and home-range sizes of 117 wild boars for 9 year period have been estimated. We found an inverse relationship between wild boar home-range size and food supply in October-December (i.e., the period of highest seed production): indeed, home-range size increases when forest productivity decreases, according to the food-exploitation hypothesis. This hypothesis has been already confirmed also for other ungulates as roe and red deer, but it was not still evident for wild boar. Due to his strong potential impact on plant communities, for example through rooting, and considering the increasing wild boar densities observed in Europe in the last five decades, the ecological role of this species in forest ecosystems and the cause-effect relationships between producer and consumer should be further investigated.

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X Congresso Italiano di Teriologia

Factors affecting demographic parameters of an Alpine chamois population and estimated response to expected climate change

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C428

The analysis of time series of abundance indexes is a key tool to investigate the effects of limiting factors on the dynamics of populations, and to estimate their future trend. Long-term time series, however, are seldom available and are prone to sampling errors. Climate strongly affects body mass and demography of alpine chamois. Furthermore, global warming has been particularly marked in high-mountain areas over the last half century, and long-term effects on chamois populations can be expected.
In the Gran Paradiso National Park (Italy), chamois were counted each autumn from 1956 to 2012, while meteorological data are available starting from 1962. Because abundance data were potentially affected by observation errors, we used a state-space model to filter the raw data and disentangle sampling error from environmental variability. We then performed a series of Generalised Linear Models to investigate if density and climatic indexes affected population growth rate, fecundity (kid-female ratio), as well as juvenile and adult survival. Best-performing models were selected through Akaike Information Criterion. Finally, to predict the response of chamois population to expected climate change, we projected the dynamics of the studied population under the climatic conditions predicted by a regional climate model.
Over the study period, chamois population showed a significant increasing trend (R^2=0.69, p<0.0001). A density-dependent effect was detected in both growth-rate and age-specific survival models, while it was less important for fecundity. Growth rate was negatively affected also by average snow depth in winter and precipitation in spring. Adult survival showed lower variability than the other demographic parameters, and was affected only by average winter snow depth. Kid-female ratio was negatively affected by winter and spring precipitations, but positively affected by snow depth in the spring of the previous year. The latter effect could have been mediated by the body conditions of mothers, possibly favoured by higher water availability for pastures. Winter precipitation and a delayed effect of spring-summer temperatures (possibly due to the shortening of the period available to feed on high-quality plants) negatively affected juvenile survival. The abundance of Alpine ibex had a negligible effect on demographic parameters of chamois.
Climate change appeared to yield positive effects on the demography of Alpine chamois, through the shortening of the snow cover period which, in turn, allowed a higher survival of both juveniles and adults. Higher temperatures in spring/summer, however, had an opposite effect on fecundity and juvenile survival. As a consequence, population projection performed using the results of empirical models of all demographic parameters showed a much stronger decreasing trend than the projection performed using the results of empirical model for growth rate. Future studies should aim addressing the effects of spring climate on pasture quality and, ideally, their effects on body mass and milk quality of pregnant and lactating females.

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Conditioning availability in resource selection functions: territoriality matters

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Ideally, Resource Selection Functions (RSFs) should be calibrated using presence *vs.* absence data, even though in most cases true absences are not available and a random set of background points (i.e., pseudo-absences) is commonly used to represent the resources available to the species. However, several factors affect true accessibility of resources rendering problematic the definition of the statistical frame to sample, and territorial behaviour is one of such. Especially dealing with site-attribute analyses (e.g., nests, den sites) in territorial species, neglecting the hierarchical nature of habitat selection associated to searching, establishing, and using a territory may introduce a serious bias in the resulting RSFs. To this aim, we empirically investigated how RSFs are affected by two different sampling strategies for background (i.e., available) points, one neglecting and the other reflecting territorial behavior (i.e., by random sampling through the entire study area or within the territory, respectively).

Our study case deals with developing a RSF to investigate selection patterns of attributes characterizing rendez-vous sites used by wolves (*Canis lupus*) in the Pollino National Park (6 packs and 9 pack-years, from 2000–2004). We detected rendezvous-sites by means of radio-tracking and/or wolf-howling, and only those subsequently verified through field surveys and used by wolves up to the end of August have been retained in the analysis. Three classes of GIS-derived variables (i.e., land use, topographic, anthropogenic) were used to assess selection patterns. We calibrated RSFs using Generalized Linear Mixed Models (GLMMs), with pack ID as a random factor, using the `lme4` R package, reflecting two different sampling designs: one contrasting rendezvous sites *vs.* random points sampled throughout the entire study area, and one contrasting rendez-vous sites *vs.* random points sampled within the corresponding wolf pack's territory (i.e., VHF-derived Minimum Convex Polygon, MCP). For each sampling design, we first measured collinearity among the variables using Pearson correlations (r>0.7) and Variance Inflation Factor (VIF>3), discarding correlated variables whose biological interpretation was less straightforward. Using a global GLMM, we then assessed for each variable the grain which best described the scale of selection, testing radial distances by increments of 500 m, from 200 m (mean rendez-vous location error) to 5583 m (mean territory radius of wolf packs in the study area). For each sampling design, we then fit multi-grain models (i.e., allowing for different grains for different variables) and used the sample-size corrected Akaike's Information Criterion to select the most appropriate models out of a set of *a priori* models. We compared RSFs reflecting the two different sampling designs by means of their coefficients and the spatial overlap between the two resulting maps.

The two sampling designs influenced the modeled patterns of habitat selection by wolves at rendez-vous sites. In particular, the extent and/or direction of some topographic (i.e., slope) and anthropogenic (i.e., distance to unpaved roads, and human density) variables varied markedly between RSFs neglecting vs reflecting territorial behaviour. As a consequence, we found a limited overlap between the two corresponding maps of rendezvous site potential habitat. According to 10-bin (deciles) distributions of the predicted probability values, spatial overlap between the lowest and the highest suitability classes of the two RSFs was rather low (51% and 38%, respectively), and it never exceeded 20% for the other classes. We conclude that in developing RSFs for territorial species, sampling of available resources should be designed to account for the limited accessibility of resources outside a given territory. In such situations a hierarchical approach, reflecting multiple orders of selection (Johnson 1980), should be preferably addressed using a nested, multi-stage, modelling approach.

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Spreading threat, enhanced diagnostics, and benign neglect management: perspectives on wolf-dog hybridization in the northern Apennines

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Anthropogenic hybridization (AH), the intermixing of individuals of two or more genetically distinct populations as a consequence of human interference, has long been recognized as an emerging threat for many plant and animal taxa. A special case of AH is represented by hybridization between a domestic species and its wild counterpart. Where domestic animals are unrestrained and have free access to the natural environment they may hybridize with descendants of their wild ancestors, and under some circumstances (e.g., small populations, fragmented ranges) rapid introgression (the spread of hybrid genetic variants into the genome of the wild parental population) may develop into a hybrid swarm (e.g., domestic and wild cats in Scotland). Wolves and dogs belong to the same biological species, are interfertile, and may produce fertile offspring. Wolf $\times$ dog hybridization (WDH) is thought to have occasionally but recurrently occurred throughout history since dog domestication, even though it was believed to be unlikely in natural settings. More recently, evidence is rapidly accumulating both in Italy and elsewhere that WDH is becoming more common and spread than previously thought, possibly as a result of protected wolf populations expanding their range in more human-dominated areas featuring large numbers of free-ranging dogs. Concurrently, the recent development of particularly effective remote sampling techniques (i.e., camera trapping, non-invasive genetic sampling), coupled with the enhanced availability of more powerful diagnostic genetic markers, enable us to more intensively, accurately and reliably detect introgressed individuals in wolf populations, and eventually assess their prevalence.

Our aim is to provide a first assessment of WDH in the Tosco-Emiliano National Park (PNATE, Northern Apennines) and adjacent areas as an *ex-ante* evaluation phase conducted within the EU-Life project "Mirco" (LIFE13NAT/IT/000728; 2015–2020). PNATE has been re-colonized by wolves by the late 80s and acts a critical stepping-stone for wolves dispersing further north along the Apennine toward the Alpine wolf population. Since 1996, in an area of about 4000 km^2 around the PNATE, we sampled wolves (live- and camera-trapping, non-invasive sampling, retrieving carcasses), and adopted the combination of genetic and phenotypic criteria developed in a preceding Life project ("Ibriwolf": `http://www.ibriwolf.it`) to identify admixed individuals. Most genetic analyses have been carried out by the Conservation Genetics laboratory of ISPRA. Hereby, we: (i) attempt a preliminary assessment of the distribution and prevalence of admixed individuals at the local scale; (ii) discuss variation of these estimates depending on the diagnostic tools used; (iii) illustrate the initiatives that the Park Authority recently activated to monitor and manage WDH locally.

Overall, from 1996 to 2016 we detected introgression in at least 7 packs across the entire surveyed area, with at least 70 admixed wolves, 54 of which genetically detected out of 213 individually evaluated. Based on non-invasive samples, during the last 6 years we suspect that a possible increase in the proportion of introgressed wolves occurred, with an overall 60% of the samples (n=44) assigned to admixed individuals, all backcrosses of second or later generation. Since 2011, we detected in the PNATE a pack entirely composed of genetically admixed individuals (n=10), even though none of them shared any of the phenotypic characters (as revealed by live- and camera-trapping) believed to be a reliable sign of introgression. Conversely, according to phenotypic characters assessed on wolves that had been live-trapped (n=8), camera-trapped ($n \geqslant 13$), or retrieved dead (n=7) the most frequent anomalous traits were a melanistic coat, white spots, and dew-claws on the hind legs. For some of these cases (n=14), we could apply both genetic and phenotypic diagnostic criteria, revealing that 9 phenotypically diagnosed admixed individuals would have been assigned to the wolf population by genetic means. This supports the notion that identification of admixed individuals is best performed using a combination of genetic and phenotypic criteria.

Accurate estimates of WDH prevalence are urgently needed to inform management, but such estimates are difficult to obtain. This is mostly due to non-consistent sampling and to the fact that fast evolving genetic markers make samples across years hardly comparable. Nevertheless, the proportion of admixed individuals that we detected in our study area requires careful attention and immediate management response by all relevant Authorities. While recognizing that AH represents a particularly difficult issue to deal with on theoretical, technical, legal, conservation and social grounds, we also contend that wolf-dog hybrids are increasingly representing nationwide a serious threat not only from a genomic perspective, but also from the ecological (i.e., competition with wolves, impact on prey populations, hosting and spreading diseases), economic (i.e., depredations on livestock, pets and wildlife), management (e.g., compensation programs, enforcement of wolf protection), and social (e.g., negatively affecting both attitudes and beliefs, increasing fear of wolves and eroding support public support for wolf conservation) points of view. If these problems are not timely and adequately addressed, their effective mitigation might reveal to be more severe and out of reach than historically postulated by the prevalent management model.

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Mitochondrial DNA-based phylogeography of the European wildcat (*Felis silvestris silvestris*) in Europe: extant structure and historical inferences on species' biogeography

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C242

The European wildcat (*Felis silvestris silvestris*) is characterized by fragmented and genetically differentiated populations. However, the phylogenetic relationships and the biogeographic history of the species is still unclear. Furthermore the long sympatry with the domestic cat that has characterized the last 10000 years makes particularly interesting the understanding of possible past introgression events. In this work we sequenced a portion of NADH-5 gene of mitochondrial DNA that contains polymorphisms able to distinguish wild from domestic subspecies and to provide good phylogeographic information. We performed a phylogenetic and phylogeographic analysis on a sample of 717 individuals (212 domestic cats, 433 wildcats and 72 putative hybrids from Scotland and Hungary) collected across Europe and previously typed at 31 microsatellite loci and assigned to their subspecies by means of Bayesian clustering. The results showed two main differentiated clades whose haplotypes featured respectively the wild and domestic polymorphisms. All domestic cats samples showed the expected domestic haplotypes. Moreover, we found that also 40.1% of wildcats shared some domestic haplotypes along with 60 putative hybrids (83.3%). The 74.7% of wildcats featuring domestic haplotypes were grouped in a separate clade that diverged from the rest of group about 37700 years ago and that was present across all Europe. The clade featuring wildcat polymorphisms showed a clear geographic structure. A first Mediterranean/continental main differentiation began about 64200 years ago followed by a separation among central Europe/Iberian peninsula, Italy and Scotland regions with typical post-glacial recolonization patterns and a degree of haplotype sharing. This work provided a comprehensive phylogenetic and phylogeographic analysis of European wildcat and tried also to clarify the origin of domestic-wild shared haplotypes advancing new and complementary hypothesis about the biogeographic history of the species and enhancing the use of these markers in wildcat conservation studies.

Laboratorio di formazione: gli Sciuridi alloctoni (in collaborazione con LIFE U-SAVEREDS)

L'introduzione ed espansione di specie alloctone è ad oggi una delle principali minacce per la conservazione della natura. Questa minaccia mostra, inoltre, un costante incremento e rappresenta pertanto una tra le future sfide chiave per le attività di gestione e conservazione delle risorse naturali. In Italia, nell'ambito dei Mammiferi, sono presenti 36 specie alloctone, di cui 31 ormai naturalizzate, con un *trend* calcolato sugli ultimi 60 anni in esponenziale aumento. L'ordine dei Roditori è quello che conta un maggior numero di *taxa* e certamente annovera alcune tra le specie con gli impatti più severi, quali i topi e i ratti, anche causa di gravi problematiche di tipo sanitario. Un caso emblematico è quello rappresentato dallo scoiattolo grigio americano, inserito nella lista di 100 tra le specie alloctone invasive più pericolose a livello globale, la cui presenza è la causa primaria di estinzione dello scoiattolo comune, unica specie di scoiattolo arboricolo autoctona del vecchio continente. Nonostante i diversi interventi legislativi, che hanno introdotto un divieto del commercio di alcune specie di scoiattoli e ne hanno regolamentato strettamente la detenzione, permangono oggi diverse popolazioni in Italia, che in mancanza di un'attenta e rapida gestione rischiano di mettere a serio rischio lo scoiattolo comune e tutti gli ecosistemi forestali del nostro paese. La gestione di tali specie, caratterizzate da un elevato *appeal* tra i cittadini, è spesso complicata, poiché si gioca anche su piani non strettamente tecnici. Le componenti emotive e sociali, infatti, rivestono un ruolo primario nella generazione di situazioni conflittuali in grado di determinare un forte limite ai progetti di eradicazione. Gli interventi gestionali, tuttavia, sono sempre più incoraggiati anche a livello europeo e la partecipazione di istituzioni e cittadini è di fondamentale importanza, specialmente quando vi sia la necessità di mettere in campo il monitoraggio e la gestione su ampia scala e in contesti antropizzati. Da qui la necessità di una formazione di operatori del settore e singoli cittadini che possa garantire l'implementazione di sistemi di sorveglianza e rapida risposta alla presenza di nuovi nuclei di scoiattoli alloctoni.

A cura di
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Tassonomia, monitoraggio e conservazione dei Mammiferi

Una corretta ed efficace strategia di conservazione si deve basare, oltre che su una dettagliata conoscenza tassonomica, anche sulle conoscenze biogeografiche ed ecologiche delle specie. In tal senso la conoscenza della corologia, dei parametri zoogeografici, dell'abbondanza delle popolazioni, delle preferenze ecologiche, del ruolo delle interazioni (ad esempio, ospite-parassita), assumono un ruolo di grande importanza. L'affinarsi delle tecniche di indagine tassonomica che variano dalla cariologia, alla morfologia, alla genetica molecolare, stanno stimolando un dibattito nel mondo scientifico che coinvolge anche il concetto stesso di specie. Un contributo importante, nell'apportare indicazioni determinanti nel dibattito scientifico in corso, può essere fornito anche dagli strumenti conoscitivi ed operativi caratterizzanti tipicamente un approccio paleontologico e paleoecologico. Aspetto non meno importante è quello che riguarda il monitoraggio delle popolazioni delle varie specie anche in funzione della conservazione e gestione dei Mammiferi con particolare riferimento a quelli che fanno parte degli impegni che lo stato italiano ha assunto in ambito europeo. Scopo di questa sessione è quello di presentare studi volti ad approfondire e a confrontare le tematiche sopra esposte.

Coordinatori

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Species Concepts and Species Delimitation in Mammals - theoretical issues and practical consequences

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C451 Opening Lecture

Species concepts are at the same time integral to taxonomy, evolutionary biology and biodiversity and highly contentious. Over the decades and centuries more than 30 different such concepts have been introduced, along with the even more fundamental question if there is anything like a species level at all that we can define. Recently, there has been a renewed debate about species concepts within mammalian taxonomy, triggered by what has been dubbed "taxonomic inflation" as a consequence of a paradigmatic shift from the Biological Species Concept (BSC) to Phylogenetic Species Concepts (PSCs), particularly to a version of the latter based on diagnosability (dPSC). The application of the dPSC to the taxonomy of the Bovidae, for example, has led to the doubling of species numbers within that group, from ca. 140 to ca. 280. At least some of the theoretical problems concerning species can be considered solved, but a solution to the main practical problem, species delimitation, remains elusive. In my talk I will present several contentious cases in mammalian taxonomy and highlight a select number of topics including:

1. Crucial conceptual distinctions that are key to avoiding unfruitful debates, such as the distinctions between species taxa and the species category or between ontological species definitions (what species *are*) and operational species criteria (how species can be *identified*).
2. A presentation of the theoretical solution to the species problem by Mayden and de Queiroz according to which there is a single ontological definition (species as lineages), while the other so-called species concepts function as identification criteria.
3. The general underlying problem of taxonomy with respect to species delimitation: fuzzy boundaries in nature due to the continuousness of the evolutionary process and the fractal pattern in the Tree of Life; or, in a nutshell: the dilemma of a discrete ordering system (taxonomy) for entities in a continuous process.
4. A brief discussion of the two concepts most often used in mammalian taxonomy, the BSC and the (d)PSC, and their shortcomings in theory and practice.

The main conclusion with regard to taxonomic practice will be (i) that species delimitation will necessarily always contain an element of convention/arbitrariness; (ii) that this is not the same as claiming that species are arbitrary units for the sake of convenience only; (iii) that neither the BSC nor the PSC (nor any other concept, for that matter) will provide taxonomists with a completely non-arbitrary methodology of describing and delimiting species; (iv) that all species concepts are based on biological realities and thus none of them can simply be wrong; (v) that species can only meaningfully be delimited in hindsight unless we are willing to accept a trivialization of the species category; and (vi) that this may be annoying in our daily work and that is has potentially serious consequences for analyses based on species numbers, but that it is a direct consequence of evolution with which we will simply have to live.

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Integrative taxonomy and bioinvasions: an useful approach to identify and manage new sciurids in Europe

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Integrative taxonomy, a multi-disciplinary approach adding modern techniques to traditional morphology-based methods (e.g., molecular and morphological criteria), can play an important role in bioinvasion research to identify introduced taxa, discover pathways of introduction and inform authorities to control and prevent future introductions. This study is the first on introduced populations of *Callosciurus*, Asiatic tree squirrels, known as potentially invasive species in Europe (Italy, Belgium and France). We combined molecular (mitochondrial DNA markers: *CoxI*, D-loop) and morphometric analysis on skulls, comparing them to the widest morphological and molecular datasets ever assembled for *Callosciurus*. Squirrels collected in Italy and Belgium shared the same haplotypes and skull characteristics, but are conspicuously different from the French population in Antibes. Genetic data revealed close similarity between French squirrels and Pallas's squirrels, *C. erythraeus*, from Taiwan. Italian and Belgian squirrels formed an independent taxonomic lineage in genetic analyses, whose taxonomic rank needs further investigation. The morphological and morphometric characteristics of these two populations are however similar to known specimens assigned to *C. erythraeus*. These results may indicate a common origin for the populations found in Belgium and Italy. In contrast, French specimens suggest an independent introduction event of squirrels originating from Asia.
In the case of invasive alien tree squirrels, that are able to establish viable populations from a few individuals, we recommend that the legislation prohibiting the introduction of squirrels in European countries should provide taxonomic lists at a higher resolution than the species level. In any case, the use of integrative approaches appears to be ever more urgent and will allow us to obtain more and faster information useful to the management of the new invasive alien species.

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Comparing the morphology of European wildcats (*Felis silvestris silvestris*) from north-eastern Italy, central Italy and central Germany

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C331

Morphological studies on the European wildcat (*Felis silvestris silvestris*) have extensively focused on the search for diagnostic characters to distinguish it from its domestic conspecific and their hybrids. However, this approach has led to the search for a "pure" form, a type that could be easily recognizable to allow more straightforward conservation actions. Therefore, little attention has been payed to this species' morphological variation and to the differences between European wildcat populations. The literature provides several genetic studies that highlight population subdivisions throughout Europe, including the case of wildcats from north-eastern Italy and from the Italian peninsula. Starting from this background, we decided to compare three wildcat populations with low levels of introgression to assess whether to their genetic differences correspond morphologic diversity as well. For this study, data were collected on carcasses and bone specimens of adult European wildcats from north-eastern Italy, central Italy and central Germany, with a total of 91 studied individuals. The comparison is based on 19 linear measures and one index concerning cranial and postcranial morphology, and the coefficient of difference, as well as an analysis of variance, were used to unravel the morphological variation. The results show significant differences between all three populations, but without a clear north-south gradient. With this study, it was possible to restate and expand the picture on the morphology of the Italian wildcat populations. Moreover, these findings should stimulate further research to reveal the morphological variation of the European wildcat throughout its whole range.

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The marsican bear (*Ursus arctos marsicanus*): morphological evidences of taxonomic and ecological distinctiveness

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In spite of the long geographical isolation, the taxonomic status of the marsican bear (*Ursus arctos marsicanus*) is still not completely accepted. If on the one side genetic analyses supported weakly this Italian endemism as distinct from other European populations of brown bear, on the other side morphological analyses of the cranium suggest that the marsican bear evolved unique features possibly driven by genetic drift and local selective pressures. In many recent studies, the mandible has proved to represent a highly informative mammalian skull component able to discriminate species, to identify ecomorphological adaptations, and to provide reconstructions of feeding ecology in extinct bears. Here, we use mandible size and shape data, quantified by means of 2D landmark based geometric morphometric methods, to test the hypothesis that the marsican bear is morphologically distinct not only from other populations of brown bear, but also from other members of the genus *Ursus*. Fourteen landmarks were digitized on lateral mandibular projections of 119 specimens belonging to the four *Ursus* species (*U. americanus* (n=16), *U. thibetanus* (n=14), *U. arctos* (n=78), *U. maritimus* (n=11)). The landmark configuration was chosen to spatially record the relative position of lower teeth (canine, fourth premolar, carnassial slicing and crushing areas) coronoid, condyle and angular process. Generalized Procrustes superimposition was performed to translate, rotate and scale the landmark configuration of each specimen to a unit centroid size. Principal component analysis, Procrustes ANOVA, and discriminant function analyses demonstrated a strong separation in mandibular morphology of the marsican bear from other populations of *Ursus arctos* and also from other members of the genus *Ursus*. The mandible of the marsican bear is characterised by a very thick corpus (both anteriorly and posteriorly), a wider ramus and a highly positioned condyle. All these features could be interpreted in the light of genetic drift or local selective pressures (e.g. diet rich in hard mast). The unique morphological features of *Ursus arctos marsicanus* should be taken into account for possible future taxonomical evaluation of the brown bear.

X Congresso Italiano di Teriologia

Geometric Morphometrics and taxonomy of *Arvicola amphibius* in Italy

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C279

The taxonomic status of the Eurasian water vole *Arvicola amphibius*, has been highly questioned and undergone many nomenclature changes since 1549, the year of its first description by Georg Agricola. This is due to the two different ways of life of these animals, which present terrestrial and aquatic populations. The purpose of our study is to investigate the cranial shape variation of Eurasian water vole in Italy using two-dimensional geometric morphometrics in order to give a contribute to the taxonomic assessment of this taxon. The study examined 84 samples of the vole skull and jaw from three Italian Museums of Natural History (Florence, Verona and Bozen), from ISPRA of Ozzano dell'Emilia (National Institute for Protection and Environmental Research) and from two private collections. Each sample was photographed and analyzed in three different skull projections (dorsal, ventral and lateral). Furthermore, picture of the jaw were collected in order to analyze teeth shape.
We used a standardize protocol to take pictures of the samples to avoid to introduce a bias in the analysis. Anatomical landmarks were collected on each photo through the software `tpsDig2`. The four raw landmark configurations (one for each skull projection and the teeth), were subsequently centered, scaled and rotated through a Generalized Procrustes Analysis (GPA) by using the software `MorphoJ`. The obtained aligned configurations (shape+size) were successively used to perform statistical analyses, using the software R. The differences in size were visualized using box-plots, grouping specimens on the basis of latitude, OTU (Italian administrative regions) and sex, and successively tested by using ANOVA test and HSD Tukey test. Shape differences were investigated by Principal Component Analysis (PCA) and Canonical Variate Analysis (CVA) vole sample and on the sample averaged by latitude and by OTU.
The obtained results have shown that there is any size sexual dimorphism. By contrast there is a significant size difference between the Italian voles and those from Germany, Switzerland and north-eastern Italy (Bozen), which are smaller than the Italian ones.
PCA and CVA performed on skull and jaw configurations suggested the presence of a latitudinal trend of shape change in all the skull projections and in the teeth. The results show that on the basis of the shape the European and Italian voles can be separated in two well distinct groups, with the first, according to deformation grids, showing a shorter and wider skull respect to the latter.
The large differences observed between the Italian and the European water voles suggest that the first can represent a distinct taxonomic entity with deserve further investigations.

X Congresso Italiano di Teriologia

Forensic genetics for wildlife conservation: is the wolf (*Canis lupus*) a threat or a victim?

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C390

After centuries of massive decline, thanks to their adaptability and to the implementation of adequate protection measures, the Italian wolves are now re-colonising sectors of their historical range. However this ongoing expansion both in remote and urbanized areas can exacerbate conflicts with local communities: on one side for the damages on domestic livestock and on the other side for historical fears about people safety, sometimes leading to increased levels of poaching.

Here we describe how forensic genetics and molecular tools can be successfully used to solve ambiguous cases of conflictual wolf- human interactions.

Using canine mtDNA control-region sequences, 12 unlinked autosomal and 4 Y-linked microsatellites, together with molecular sexing, we reconstructed individual genetic profiles to establish the species and population of several forensic samples.

In the first case, we analysed DNA extracted from a confiscated necklace of ten presumed wolf canid teeth. The obtained genotypes belonged to six different individuals, which were unambiguously assigned to the Italian wolf population by Bayesian procedures, documenting for the first time a case of serial wolf killing in Italy.

In Europe, most of livestock predations are attributed to wolves, though free-ranging dogs can locally contribute to a significant portion of the losses. Moreover, false attacks are sometimes declared by breeders in order to obtain compensations. Thus, in the second case we analysed 33 salivary DNA samples collected from the bites on the carcass skins of 13 sheep and one horse, presumably predated by wolves in seven farms in Central Italy, finding that eight sheep were killed by wolves, whereas one was killed by a female dog and the horse was post-mortem consumed by a male dog, contrary to what declared by the breeder.

Finally, the case of a presumptive wolf attack on humans in the Norther Apennines was solved by analysing the biological samples collected on the aggression scene. Not surprisingly, the findings indicated that the man was not attacked by a wolf, but actually mauled by a property dog, namely a male American Akita, a large Japanese breed used for defence.

These examples demonstrate that, when reference populations are genetically typed, forensic techniques can help to deeper understand the real impact of wolves on livestock damages and human safety and to discover poaching episodes, contributing to a better conservation of the species.

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primates in human-modified and fragmented landscapes: the conservation relevance of modelling habitat and disturbance factors in density estimation

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C267

Accurate density estimations of threatened animal populations is essential for management and conservation. This is particularly critical for species living in patchy and altered landscapes, as is the case for most tropical forest primates. In this study, we used a hierarchical modelling approach that incorporates the effect of environmental covariates on both the detection (i.e. observation) and the state process (i.e. abundance) of distance sampling and that allows to model animal density in a spatial explicit framework. We applied this method to already published data on three arboreal primates of the Udzungwa Mountains of Tanzania, including the endangered and endemic Udzungwa red colobus (*Procolobus gordonorum*). The area is a primate hotspot at continental level. Compared to previous, "canonical" density estimates, we found that the inclusion of covariates in the modelling makes the inference process more informative, as it takes in full account the contrasting habitat and protection levels among forest blocks. The correction of density estimates for imperfect detection was especially critical where animal detectability was low. Relative to our approach, density was underestimated by the canonical distance sampling, particularly in the less protected forest, where animals can go easily undetected and are unevenly located within the sampled area. The method we applied represents indeed a valuable tool for the study of threatened and/or low density populations, as failure to model covariates of detectability and abundance will likely produce biased density estimates. We also found that group size had an effect on detectability, determining how the observation process varies depending on the socio-ecology of the target species. We showed how accounting for the effect of group size on animal detectability is particularly important for species or populations with small social units. Lastly, the inference on density is spatially-explicit to the scale of the covariates used in the modelling, when these are available across the study sites and beyond the field sampled points, providing a critical tool to predict the status of populations in fragmented or heterogeneous landscapes. We could thus confirm that primate densities are highest in low-to-mid elevations, where human disturbance tend to be greater, indicating a considerable resilience by target monkeys in disturbed habitats. However, the marked trend of lower densities in unprotected forests urgently calls for effective forest protection.

X Congresso Italiano di Teriologia

Predicting population expansion after reintroduction: the case of European beavers (*Castor fiber*) in Serbia and Bosnia-Herzegovina

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Species distribution models may provide important information in the follow-up phase of reintroduction operations by helping to predict the main areas most likely to be colonized by the reintroduced species. In this study, set in Serbia and Bosnia-Herzegovina, we focused on a "keystone" mammal species associated with wetland and riparian habitats, the European beaver (*Castor fiber*).

Beavers have been reintroduced to many regions of Europe after being driven to extinction by overhunting by the beginning of the 20th century. In Serbia and Bosnia-Herzegovina the species has been reintroduced in 2004–2006.

Based on occurrences of beavers in the study area from its reintroduction to date we developed Species Distribution Models. We used the `biomod2` package which offers the possibility to run different modeling techniques and combines them in a final ensemble model that describes the relationships between a given species and its environment. Models achieved excellent levels of predictive performance according to receiver operating characteristic analysis (ROC) and true skill statistic (TSS).

The analysis of single variable importance showed that distance from rivers (importance=50%), altitude (35%), distance from other water bodies (30%) and presence of agricultural lands (25%) were the main factors influencing model performance. Distance from inland marshes and from broad-leaved forests provided a total contribution of 28%. Based on the model prediction the percentage of suitable habitat for the beaver is about 8.5% (19000 km^2) of the whole region of which 54% (10150 km^2) falls outside its current distribution range, especially in the south of Bosnia and south-east Serbia.

From the analysis of beavers dispersal pattern emerged that from 2004 to 2014 mean colonization speed was 154.77$\pm$58.45 km/year (mean$\pm$SD).

Based on our model, only 1.77% of Bosnian and 6.32% of Serbian suitable habitat for the beaver lies within the national network of protected areas.

We detected new potential areas where beavers will likely settle in the near future, advising on where surveys should be focused. Moreover, we also identified low suitability areas that can be targeted with appropriate habitat and landscape management to improve their conditions as well as important regions falling outside reserve where protection should be granted.

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A new approach for non invasive brown bear genetic monitoring in Italy: the effectiveness of a newly developed 96×96 SNP-chip on the Alpine and Apennine populations

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Species with small and isolated populations, like brown bear in Italy, are highly threatened by demographic and genetic factors and need to be monitored in order to prevent extinction in the long term. Individual identification (DNA fingerprinting) is of prime importance in monitoring carnivore populations, since it enables to count the minimum number of individuals, estimate effective population size and measure demographic parameters. Moreover, identifying individuals is the first step for assessing kinship relationships, and thus obtaining information relating to reproductive success and risks of inbreeding depression. In the last two decades, microsatellites (STRs) have been the marker of choice for monitoring carnivore populations through non-invasive samples. Nevertheless, non-invasive samples are usually characterized by degraded and low-quality DNA, and the use of STRs often leads to low amplification rates and genotyping errors. This issue can result in identification of erroneous genotypes with a consequent overestimation or underestimation of individuals. Recently single nucleotide polymorphisms (SNPs) have emerged as more valuable genetic markers in conservation genetics, thanks to the following characteristics: a) the detection of SNPs requires the amplification of shorter DNA fragments which have a better chance to amplify compared to STRs b) SNPs do not require calibration of allele calling across different laboratories c) SNPs analysis is easily automated, less time consuming and less cost effective if compared with STRs analysis. For these reasons, SNP panels are becoming a routine application in carnivore monitoring projects.

In this study, we tested the effectiveness of a 96×96 SNP-chip in terms of resolution on the two Italian brown bear subspecies (*Ursus arctos arctos* and *Ursus arctos marsicanus*), in order to identify two subsets of SNPs that have potential for a SNP-based individual and sex identification system. The 96×96 SNP-chip was previously developed selecting highly polymorphic SNPs in the Scandinavian brown bear populations. The SNP-chip comprises 4 mtDNA homozygous SNPs for phylogeographic lineage identification and species confirmation, 4 SNPs on Y-chromosome and 3 SNPs on X-chromosome for sex determination. The remaining 85 SNPs are autosomal and are used for individual identification through multilocus genotyping.

We genotyped 55 non-invasively collected hair samples (*Ursus arctos arctos*: 28 samples; *Ursus arctos marsicanus*: 27 samples) at all 96 SNPs. The samples belonged to 55 different bears, and were selected covering the full geographic range of both subspecies in Italy. We selected the SNP subsets choosing among those SNPs with higher genotyping success, cluster reliability and high variability. 9 out of 96 SNPs didn't show signs of amplification and 14 (excluding mitochondrial and Y-chromosome SNPs) were monomorphic in both subspecies. 42 SNPs were fixed in *Ursus arctos marsicanus*, whereas only 2 SNPs were fixed in *Ursus arctos arctos*. We finally found a total of 51 and 15 autosomal SNPs to be variable and reliable in individual identification for *Ursus arctos arctos* and *Ursus arctos marsicanus* respectively. The 51 SNPs were able to distinguish individuals of *Ursus arctos arctos* (unbiased probability of identity SNPs PID 7.9×10^{-17}; unbiased probability of identity among siblings SNPs PIDsibs 5.5×10^{-9}) providing better resolution power to that derived from 15 STRs genotyped in the same samples (STRs PID 3.8×10^{-13}; STRs PIDsibs 6.4×10^{-6}). Differently, 15 SNPs were not enough to distinguish individuals of *Ursus arctos marsicanus* (SNPs PID 1.5×10^{-4}; SNPs PIDsibs 1.1×10^{-2}) and were less powerful than 11 STRs genotyped in the same samples (STRs PID 9.2×10^{-5}; STRs PIDsibs 9.4×10^{-3}).

Therefore, this new approach can be effectively used for a wide range of purposes in the *Ursus arctos arctos* subspecies, from the routine demographic monitoring of the species in Italy, to studies concerning effective population size, reproductive success, genetic diversity, inbreeding, dispersal and phylogeography. Regarding the *Ursus arctos marsicanus*, a *de novo* SNP discovery is essential for obtaining an acceptable resolution power.

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Monitoring Mammals with camera trapping: results from the first year of implementation of a systematic protocol in the eastern Alps

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C301

As human activities continue to impact biodiversity, there is an increasing need to monitor trends in the abundance of vertebrate populations. Indicators to measure the state of biodiversity against the Aichi Biodiversity Targets 2011–2020 should come primarily from data that are collected using consistent field methods across several sites. In the case of medium to large mammals, camera trapping has become a tool of choice, especially when coupled to modern, hierarchical analytical approaches in population ecology that consider both the state (abundance) and observation (detectability) processes involved in abundance estimation.

We used presence-absence camera trap data collected in western Trentino to propose a baseline assessment of the community of medium-to-large mammals. We applied, to our knowledge for the first time in Europe, a sampling protocol developed by the Tropical Ecology Assessment and Monitoring (TEAM) Network, a pan-tropical network for monitoring long-term trends in biodiversity, land cover, climate and ecosystem services in tropical forests. The "Terrestrial Vertebrate Monitoring Protocol" provides a standardized and efficient way to monitor the status of species and communities of vertebrates using camera traps. We sampled a focal study area of approx. 220 km^2 partially overlapping the Adamello-Brenta Natural Park in its southern portion. We used 60 sampling locations, with camera traps running for at least 30 days at each site, and deployed through two sequential arrays overall running from June to August 2015. We cumulated 1978 camera days that yielded 9903 images of 12 species of wild mammals, from a total of 49595 images that also included blank images, birds, people, domestic animals and vehicles. We analysed presence-absence data to model both occupancy and detection probability with a set of potential environmental and disturbance covariates of species occurrence, for each of the eight most recorded species. Such occupancy modelling revealed novel ecological knowledge for some of the target species: for example, we found a negative correlation of brown bear's (*Ursus arctos arctos*) detectability with the camera trapping rate of people and permanent sources of anthropic disturbance such as settlements; we also found increasing estimated occupancy of the chamois (*Rupicapra rupicapra*) occupancy with increasing elevation and slope. In addition, we analysed data for patterns of co-occurrence and/or temporal overlap of activity patterns among species. We also addressed potential sources of variation on the results due to sampling procedures such as the effect of using two different camera models and setting camera traps along forestry roads or different types of trails.

Our study validates the usefulness of camera trapping combined with occupancy analysis to assess the target community of forest mammals, providing ecological and conservation-relevant knowledge on distribution, habitat associations and effects of anthropogenic disturbance on abundance. In addition, it provides for a baseline sampling upon which building an efficient and cost-effective long-term monitoring of mammals, which will allow to monitor progresses against Aichi Targets, particularly through the computation of the Wildlife Picture Index, an official indicator for the CBD to monitor biodiversity trends. Finally, our study is proposed as a model for possible replication in other areas in the Alps and/or at national level, as a multi-region configuration would dramatically augment the generality and conservation relevance of findings.

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La Rete regionale di monitoraggio dei Chirotteri nella regione Lazio

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C332

La Regione Lazio, per ottemperare a quanto disposto dall'art. 7 del DPR 357/97 e agli artt. 11 e 17 della DIR 92/43/CEE, ha istituito nel 2013 la Rete regionale di monitoraggio dei Chirotteri (*ChiroNet_Lazio*). La Rete ha coinvolto soggetti esterni all'amministrazione regionale (Università degli Studi di Napoli "Federico II", Tutela Pipistrelli - onlus, Gruppo Italiano Ricerca Chirotteri) ed il suo funzionamento è permesso da 18 referenti, tra cui 3 in rappresentanza dei soggetti esterni all'Amministrazione regionale, e da 63 rilevatori (*sensu* DGR 497/2007), dipendenti qualificati della Regione in servizio presso gli uffici centrali o presso le aree naturali protette, formati a partire dal 2008 attraverso seminari tenuti da chirotterologi specialisti.

Le attività finalizzate al monitoraggio, *stricto sensu*, dei Chirotteri nel Lazio affondano le radici nel 2007, quando venne avviato, insieme all'Università "Federico II", un progetto per l'analisi distributiva della chirotterofauna nel territorio regionale, che ha coinvolto 20 aree naturali protette e la formazione di 64 rilevatori che hanno effettuato un primo *survey* attraverso l'uso dei *bat detector*. L'analisi bibliografica, di campo e delle registrazione ultrasonore ha portato, nel 2009, all'elaborazione di una prima banca dati di 1700 record utilizzata per tutte le successive attività riguardanti i Chirotteri.

Le attività della *ChiroNet_Lazio* sono state programmate a partire da ottobre 2014 ma solo nel maggio 2015 sono state avviate le attività di campo che coinvolgono tutti i territori del Lazio. L'obiettivo della Rete è quello di raccogliere dati sulle tendenze dei popolamenti di Chirotteri nel Lazio, in siti prescelti e con modalità che consentano la facile e standardizzata raccolta dei dati da parte di personale qualificato ma non specialista, da perpetrarsi nel tempo per il monitoraggio dello stato di conservazione delle specie. Per questi motivi, in sede di prima attuazione, si è scelto di indagare solo siti con presenza di specie troglofile. Partendo dalla banca dati prodotta nel 2008 dall'Università "Federico II" per la Regione Lazio e sulla base di ulteriori informazioni raccolte, è cominciato lo *screening* dei siti per la verifica dell'effettiva presenza di colonie, della consistenza e tipologia (siti *nursery*, *hibernaculum* e siti di *swarming*).

Per quanto neonata, la *ChiroNet_Lazio* ha iniziato a produrre i suoi primi frutti: grazie all'esplorazione del territorio e all'utilizzo di tecnologie avanzate, quali la termografia, sono stati registrati i primi 90 record riguardanti *roost*, sono stati scoperti o rivalutati quattro siti riproduttivi con un numero di individui dai 1000 ai 6000, un sito invernale con più di 3000 individui ed è stato avviato il monitoraggio nei primi 24 siti identificati.

La Rete dovrebbe coprire l'intero territorio regionale, diviso in 15 macroaree; per ciascuna di queste è stata fornita una dotazione minima strumentale per le attività di campo dei rilevatori (ad es. *bat detector*, videocamere IR, torce ad illuminazione fredda, caschi ecc.) ed una parte di strumentazione ad uso degli specialisti della Rete che intraprendano ricerche all'interno della Regione (ad es. registratori automatici). La rete così avviata, inoltre, potrà essere utilizzata come struttura operativa di base per attrarre finanziamenti, in particolar modo quelli europei, su cui fondare l'avvio di ricerche e studi a scala regionale o più ampia.

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Small Mammals species-richness, biomass and energy flow along an altitudinal gradient in the Alps

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C249

Elevational gradients are known to shape the distribution trend of most living species, according to the variation of many biotic (primary production) and abiotic (humidity, oxygen and carbon dioxide partial pressure, temperature) factors due to altitude. Species richness decline seems to be not monotonic with increasing altitudes, differently from what observed with latitude. The energy availability acts as a constraint to the number of species and the number of individuals per species which may inhabit a specific area. In most of the published works on small mammals, the peak in species richness occurs at intermediate altitudes (mid-domain effect, resulting in a hump-shaped relationship), in conjunction with peaks of precipitation, primary productivity and habitat complexity as well. At intermediate altitudes, lowland species reach their maximum altitude and subalpine/alpine species the lowest one. In this work, we analyzed the variation in species-richness and total biomass of terrestrial small mammals (i.e. Rodents and Soricomorphs) along an altitudinal gradient. Hedgehogs, squirrels and marmots were excluded from the analyses as not catchable with the typologies of traps used in this study. The field metabolic rate (FMR) of Rodents and Soricomorphs was estimated through the Nagy's allometric equation for both those taxonomic families, calculated at every altitudinal level. Within the thermoneutral zone, the FMR is proportional to the individual body mass at the 0.507 power for Rodents and at the 0.885 power for Soricomorphs. FMR can be used as an index of the total energy flux, which was obtained by multiplying the FMR with the abundance of each captured species. Our work was conducted at the Gran Paradiso National Park in North-Western Italy (Piedmont and Aosta Valley), where three transects of 40 trap-points (separated 10 m one another) were carried out on 7 altitudinal levels between 800 and 2600 m above sea level. Transects were replicated during two capture sessions, the first between May and July 2015, the second between July and September 2015, with 135 traps/transect for the former session and 146 for the latter one. Each transect was maintained active for three days and three nights (405 trap-days per transect for the former session, 438 for the latter). Captured animals were individually marked through fur-clipping, sexed and weighted. Data from all the transects at the same altitudinal level were pooled together for the analysis. A total of 971 individuals was captured (888 Rodents and 83 Soricomorphs), belonging to at least 7 species of Soricomorphs and 10 species of Rodents. Species trapped with only one individual were excluded from further analyses. Our dataset fitted within the prediction of a hump-shaped relationship, with a peak of species-richness at intermediate altitudes (1400–1700 m), where lowland species reach the maximum altitude and subalpine and alpine species the lowest one, and where the last deciduous plants meet conifer forests originating mixed woodlands. Accordingly, the highest peak of the total biomass and energy use of Rodents occurred at 1400 m, where the highest number of individuals and most of the heaviest species were trapped. By contrast, biomass and energy use of Soricomorphs peaked at 2000 m, at the limit of the tree line, where, during the summer, a number of invertebrates and their larvae, which build up the staple of their diet, occurs. Thus, peak for rodents occurred where deciduous woodlands overlap with coniferous woodlands; peak for shrews occurred at the intersection between conifers and prairies.

Workshop: fauna e comunicazione: come fronteggiare le "bufale" in campo faunistico

Conservazione faunistica e comunicazione di massa sono un binomio dalle conseguenze potenzialmente molto pericolose in particolare quando si trovano ad essere in contrapposizione, tanto da mettere talvolta a rischio progetti di ricerca, azioni di tutela di specie e habitat e addirittura la conservazione di alcuni gruppi animali o zoocenosi (si pensi, ad esempio, alle dinamiche sociali legate alla tutela dei grandi carnivori o all'eradicazione delle specie alloctone).

La recente "democratizzazione dei media", legata all'esplosione di mezzi di comunicazione più veloci, più emotivi e privi di un confine tra chi produce e chi consuma informazione, ha portato alla proliferazione di informazioni non controllate e spesso scorretta. Ciò si è tradotto nella nascita di vere e proprie "bufale", notizie prive di fondamenti scientifici, clamorosamente irreali e che della notizia originaria non hanno più nulla. Questo processo di falsa informazione sta avvenendo in tutti i campi della scienza, dalla medicina alla fisica alla paleontologia, per citarne solo alcuni, e le discipline faunistiche (biologia, ecologia, etologia, sistematica, conservazione delle specie animali) non ne sono immuni. Di fronte a una "bufala" su un singolo animale, una specie o una zoocenosi, chi si occupa di comunicazione faunistica si trova spesso impreparato e non è in grado di fronteggiare l'evento per più motivi: mancanza di professionalità, difficoltà ad agire prima che la bufala nasca e si riproduca (una bufala può avere una corposa prole!), scarsità di fondi dedicati alla comunicazione, interferenze da parte di politici o amministratori, mancanza di una strategia di comunicazione pianificata sul lungo periodo e così via. Il *workshop* sarà quindi focalizzato sulle "bufale" comunicative (mutuando dalla biologia, potremmo dire sulla loro *life history*) e avrà due obiettivi: analizzare i problemi sopra evidenziati, con particolare riferimento alla fauna, e proporre "soluzioni" su come fronteggiare le "bufale". A tal fine, attraverso un percorso partecipativo e con l'ausilio di esperti, si illustreranno diversi approcci al "problema bufale" per arrivare poi alla stesura di un breve decalogo.

Coordinatori
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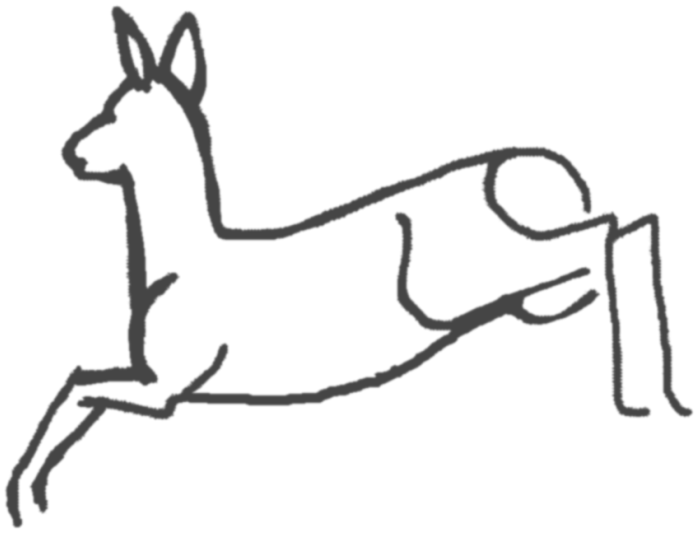

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X Congresso Italiano di Teriologia

Project to estimate the wild boar (*Sus scrofa*) mating season in the province of Rieti, results from the survey conducted during the hunting season 2015/2016

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It is well known, and it has been reaffirmed by the Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA) in a recent conference about wild boar, that in the "normal" years the suida has a single mating season lasting about nine months from September to May. The distribution of the mating events is roughly Gaussian, with a peak during autumn-winter and a spread of about 3 months from November to January. The birth season is also roughly nine months long (from January to October) but is more intense between April and May. In particular years, characterized by consecutive years of autumns with abundant fruits, mild winters, and cool and rainy summers, there can be two reproductive seasons. The first one will have mating in September and birth in June; the second one, for young females who have reached puberty and, in a smaller extent, adults in good shape, will see mating in May-June and births in October. In mountain areas like the one considered in this work, because of the mild winters, the extension of forests enlarging and diversifying the trophic level, and the presence of hybrids from cross with a domestic pig, the births are concentrated in spring (45%) with fewer cases in summer (15%), autumn (15%) and winter (20%). The low life expectancy can stimulate an early reproduction, and such a condition can be traced in the area of the province of Rieti, for which it is estimated an annual hunting that routinely exceeds 5000 boars (without accounting for the animals killed illegally in the protected areas). This study, conducted in collaboration with the DAFNE of Università degli Studi della Tuscia and the Istituto Tecnico Agrario "Luigi di Savoia" in Rieti, aims to verify within the province the boar mating tendency reported by ISPRA. The survey, of a length of 5 years (covering the hunting seasons between 2015–2016 and 2019–2020), will benefit from the fact that the students of the Instituto come from the innermost mountain regions of the province. They, duly trained by teachers of the University of Viterbo in the perspective of Citizen Science, will collect data on the number of boars killed in their town of origin. To regulate the procedure we have provided a sheet which, for each animal, collects the following information: date and location of killing; number of hunters and hounds participating to the hunting; possible size of the herd the animal belonged to; presence and number of striated boars in the herd; sex; age; weight; signs of hybridize with a domestic pig; the numbers of fetuses and their length in millimetres in the case of pregnant females. The age of the killed animals is estimated by looking at the teeth. The length of the fetuses allows to recover the time of mating of the pregnant females (age of the fetus in days), according to the explanatory note published in 2003 by the Ministero per le Politiche Agricole e Forestali e dall'Istituto Nazionale per la Fauna Selvatica "Alessandro Ghigi". The survey covers so far the animals killed by 22 hunting teams (roughly 21% of the total number of teams declared at the provincial Administration office and operating in the province of Rieti during the last hunting seasons) and 6 individual hunters. From the beginning of the hunting season, mid-October 2015, to the end of the year we have registered 252 females, of age between 5–6 months and 8–10 years, and weight between 31 and 141 kg. 13.1% of these had characteristics suggesting a possible cross with the pig. From the inspection of the uterus we discovered that 42.86% of females with age between 1 and 8–10 years, and weight between 51 and 141 kg, were pregnant. We found a variable ratio of fetuses/female, ranging between 3 and 11. The dimensions of the fetuses let us estimate the mating seasons, which have been grouped in the three 10-day phases in each month and are distributed as follows: 6.48% in the second phase of August, 3.70% in the third phase of August, 4.61% in the first phase of September, 21.30% in the second phase of September, 15.74% in the third phase of September, 4.62% in the first phase of October, 18.10% in the second phase of October, 9.26% in the third phase of October, 17.59% in the first phase of November, 6.48% in the second phase of November. Considering that the availability of acorns stimulates reproduction, and the intensity of fruiting in forests can be variable over years, we have launched in parallel a five-year monitoring of food availability in the forests for the wild boar. To this end, 12 areas with equally distributed chestnut, oak and beech forests have been prepared. At the end of five years of monitoring this will relate the reproductive dynamics with food availability in the wild.

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Wandering of boar-hunting dogs in the province of Rieti during the hunting seasons 2014/2015 and 2015/2016

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In 2012 a study comparing the predation of sheep and goats in the province of Rieti (Lazio) and in a region in the province of Oristano (Sardinia) during the two-year period 2010/2012 reported a very similar number of preys in the two territories. Data on the density of stray dogs, even if not updated, also highlight a rough similarity between the two territories (1.62 and 2.68 animals/m^2). The two territories however differ substantially in the possible kind of predator of sheep and goats present in the area; while stray dogs are present in both, the wolf, always present in the province of Rieti, has never settled in Sardinia. This latter species is the main cause of difference between the scenarios in the two territories. Wandering dogs preying on sheep and goats is a well-known and monitored phenomenon on the Sardinia Island, even though no regulation exists for the damage caused. Breeders, if they want it, can stipulate a specific insurance policy. People suffering damage report their complaint to the police who will then investigate to trace the predators; where identified, the owners of the dogs will be considered responsible for the damage. During the two-year period investigated in 2012, 304 animals were preyed in the province of Rieti (all ascribed to the wolf and for which there is guaranteed compensation from the Lazio Region), and 323 in the province of Oristano (all ascribed to wandering dogs and in many cases with identified owners). From that study it also emerged that often the dogs are boar-hunting species (various races of bloodhound) that had walked away from the hunting area and had wandered in the territory for a variable number of days. This ascertained phenomenon in Sardinia can easily arise in the province of Rieti as well. However in Rieti, as in most of the Apennines region, the predator is almost uniquely identified with the wolf, mostly because damage by dogs would not receive compensation. On these bases we start this new study, in collaboration with the DAFNE of Università degli Studi della Tuscia and the Istituto Tecnico Agrario "Luigi di Savoia" in Rieti, to estimate, in the province, the cases of dogs wandering off the boar hunting areas and the duration of their uncontrolled wandering. The investigation of this phenomenon will provide more comprehension of the dynamics at work, especially considering the current bias on attributing damage to the wrong predator so as the breeders suffering damage can get compensation. We plan a five-year survey (2014–2015/2018–2019) conducted by the students of the Istituto Tecnico Agrario, taking advantage of the fact that the students come from the innermost regions of the province. They, duly trained by teachers of the University of Viterbo in the perspective of Citizen Science, will have the task of collecting data from boar hunting teams operating in their towns of origin (so far relative to the hunting seasons 2014/2015 and 2015/2016). To standardise the procedure we have provided a sheet which, for each hunting team, collects the following information: ID, number of dogs used in the hunting, potential equipment of GPS radio collars, number of days they have been hunting in the two seasons, number of times the dogs did not come back at the end of the hunting, number of days the dogs have been wandering. Preliminary data have been collected from a random sample of 22 teams (roughly 21% of the operating teams in the last two seasons) and 6 individual hunters. The analysis of these data shows: during the two seasons considered so far there have been 1224 hunting days (with an average 21.86 days/year/team; S.D.=$\pm$9.72); each team used on average 8.14 dogs per hunting day (S.D.=$\pm$2.56); 175 times dogs wandered off the hunting area (corresponding to 14.30% of the hunting days) for a duration of: 1, 2, 3, 4, 5, 6, and more than 6 days in the 41.71%, 18.29%, 14.86%, 8.57%, 8.00%, 6.86%, 1.71% of the cases, respectively. The diffusion of GPS radio collars, put on the dogs to help finding them at the end of the day, is progressively reducing the dogs wandering off the hunting areas. The people interviewed almost unanimously believe that this phenomenon was much more spread in the past. Given the frequency of the cases, to minimize wandering hounds and their possible impact on livestock and zoocenosis, the use of GPS radio collars should be an obligation and not an option left to the will of the hunters.

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Shortage of wild boar (*Sus scrofa*) killing in the province of rieti during the hunting season 2015/2016: periodic fluctuation in the hunting or reduction of the number of animals?

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This work is the product of a collaboration between the DAFNE of the Università degli Studi della Tuscia, the Istituto Tecnico Agrario "Luigi di Savoia" in Rieti and the provincial branch of the hunting organization Italcaccia. The study, performed within the usual annual monitoring of the number of killed boars in the province of Rieti, aims to verify if there is a connection between the number of kills in the hunting season 2015–2016 and the apparent shortage of boars in the area. The hunting teams have, in fact, complained more and more frequently and widely about boars shortage, presenting official complaints against the institutions responsible for the management of the boar hunting: Ufficio Caccia of the Amministrazione Provinciale, Ambiti Territoriali di Caccia (ATC Rieti1 and Rieti2), and hunting organizations. A recent survey covering 18 European countries shows that the hunting is growing everywhere, even if significant reductions may occur periodically in some countries. In Italy big drops in hunting occurred in 1995–2000, 2000–2005 and 2005–2010. The survey also reports that the hunting effort in progressively decreasing and the number of boars is constantly increasing. The dynamics of the boar population in the province of Rieti can be caused (among other possibilities) by the modality of the killing. Indeed, we cannot exclude that the non-selective killing is impacting some age classes and it is well known that the survival of females less than 1 year old in the very hunted areas or females more than 2 years old in less hunted areas drives enormously the growth of the population. Climate changes and the availability of food in the woods will also have an effect on the demographic trends. All these factors are under investigation in the whole province. The current law establishes that at the end of each hunting day hunters have to report on the number of killed animals, their gender and age. This process should, theoretically, give a summary of the extent and quality of the hunting at the end of each season. However, already since 2008, in the province of Rieti a clear difference emerged between the official reports and the unofficial estimates of the real kills. The unofficial estimates are based on annual statistics from a random sample of hunting teams that, anonymously, declare what they officially reported and what were instead the true kills, hidden for a variety of reasons. The number of teams that, over time, agreed to contribute to these estimates has progressively increased, going from 15 in 2008 (11% of the total number of teams) to 20 in 2015 (about 15% of the total number of teams). The corrections that need to be applied to the official reports to have the real picture of the hunting have been validated and presented in scientific conferences of international relevance. They have also been used by the provincial administration and the ATC during the last hunting seasons to establish the number of allowed animals for the 130 hunting teams operating in the province. In 2008, on average, in the province of Rieti only 54% of the kills were actually reported while 64% in 2015. The unofficial estimates of the real kills during the last 3 hunting seasons show that: the average number has varied from 43.8 animals/team/year (S.D.=$\pm$24.31) in 2013/2014, to 47.9 animals/team/year (S.D.=$\pm$29.8) in 2014/2015, to 21.8 animals/team/year (S.D.=$\pm$13.5) in 2015/2016; with a reduction in 2015–2016 of 50.3% with respect to 2013–2014 and 54.5% with respect to 2014–2015. The considerable kills reduction registered in the last season could be explained with the periodical fluctuations mentioned above or with a real substantial decrease in the boar population. The latter explanation would be in agreement with what has been claimed (maybe with some prejudice) by the hunters. The possible drop in the number of animals cannot be estimated in relation to the decrease of the kills. Some attempts in this respect have in fact been made and some authors have criticized the assumptions of: a linear correlation between the number of kills and the abundance of the population, and that all the animals have the equal probability to be killed. For this reasons, we cannot currently draw any conclusion and highlight the need of further detailed studies to predict the future scenarios. If the anomalous statistics of the last hunting season were indeed the sign of a progressive reduction in the boar population, we could expect a gradual decrease of the current conflict with farmers. If, instead, the statistics were simply reflecting a reduction of the kills caused by a progressively decreasing hunting effort and/or by the overall hunting efficiency, with the same biological or ecological conditions for the boar, we could expect an uncontrolled growth of the population with consequences for the social conflict and impact on the biocenosis.

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Comunicazione attraverso le collezioni: cambiamenti ambientali locali e globali nel progetto di un piccolo allestimento su micomammiferi al Museo del Fiore

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La comunicazione museale ha il suo perno nelle collezioni e una recente acquisizione e studi a scala decennale sono da stimolo per elaborare un percorso e un progetto per una riflessione sui cambiamenti diacronici locali e globali. I micromammiferi terrestri, avendo un ciclo vitale breve che permette di rispondere rapidamente alle modificazioni ambientali, sono da lungo tempo utilizzati per il monitoraggio di vari parametri ambientali e nella Riserva Naturale Monte Rufeno già dalla metà degli anni '80 del secolo scorso sono stati condotti studi delle comunità di micromammiferi attraverso l'analisi del contenuto delle borre di un predatore generalista, il Barbagianni *Tyto alba*.

In particolare è stata analizzata, in momenti diversi, la microteriocenosi mediante due raccolte di borre, la prima effettuata negli anni 1984–1985 e la seconda nel 1997, provenienti un sito di nidificazione del Barbagianni nella Riserva naturale (loc. Campo del Prete) che risulta localizzato lungo la Sezione esterna del Museo del Fiore (Sentiero natura del fiore) e che risulta essere anche l'ultimo sito di nidificazione all'interno della Riserva dallo strigiforme fino agli primi anni 2000.

I risultati ottenuti dall'analisi dei rigetti di Barbagianni indicano che nelle 2 raccolte (1984–1985 e 1997) indicano un elevato grado di diversificazione e complessità delle microteriocenosi, costituite in entrambi i casi da almeno 10 specie, e un livello trofico del predatore che risulta essere alto e maggiore a fine anni '90 (0.36) rispetto a quanto osservato a metà anni '80 (0.29) a causa dell'aumento di consumatori secondari come i Soricomorfi nella dieta del rapace. Inoltre il valore di fine anni '90 risulta essere al di sopra sia dei valori ottenuti in altri 14 siti all'interno della stessa Riserva monitorati nel decennio precedente, sia della media ottenuta per territori più ampi vicini. Ciò indicherebbe un buono stato di integrità ambientale e di maggiore complessità degli ecosistemi della Riserva. Per quanto riguarda il grado di termoxerofilia dell'area, misurato attraverso un appropriato indice, l'area, a bioclima temperato (evidenziata dal valore negativo assunto dall'indice), sembra tendere verso un bioclima più mediterraneo, come si evince dalla riduzione del valore dell'indice dalla prima (-0.64) alla seconda raccolta (-0.32). Tale risultato è in linea con quanto osservato in altre località italiane dove, negli ultimi decenni, si osserva un aumento generale dell'abbondanza delle specie termoxerofile di micromammiferi dovuto a un cambiamento nelle condizioni climatiche, soprattutto con un aumento delle temperature e una riduzione del numero di giorni di pioggia nelle aree considerate (i.e. *global warming*).

La serie di dati e i reperti raccolti ci consentono di ipotizzare il progetto per un nuovo allestimento presso il locale Museo del fiore con la finalità di far cogliere, nel concreto e attraverso una collezione, gli effetti possibili di cambiamenti locali e globali. L'allestimento sarà posizionato all'interno della sezione "Le relazioni ecologiche" del Museo del Fiore, a fianco del "camino parlante" con le voci dei vecchi mezzadri della casa contadina; l'allestimento prevede come elemento chiave una coppia tassidermizzata di Barbagianni intenti a scambiarsi una preda e, sotto, una rappresentazione della comunità microteriologica per livello trofico nei tre decenni, riportando i crani delle specie rilevate nel sito in proporzione alla loro frequenza relativa.

Questo tipo di esposizione può permettere di mettere in relazione le variazioni di composizione della comunità con fenomeni sia locali, come il recente abbandono delle pratiche antropiche estensive, (anche nell'area pre parco, al confine del quale il sito è localizzato) sia a dinamiche globali di cambiamento climatico, come sembra suggerire la mediterraneizzazione della comunità microterilogica, osservabile dall'aumento, ad esempio, di specie termoxerofile quali i Crocidurini.

Questo allestimento completa le riflessioni della sezione museale interpretando anche queste variazioni osservate con l'azione dell'uomo e fornendo un ulteriore strumento didattico e comunicativo per una riflessione sulle conseguenze delle azioni nel nostro vivere quotidiano in una chiave di sostenibilità. I rimanenti esemplari non esposti raccolti con gli studi saranno conservati in una collezione di studio anche per confronto con ulteriori studi futuri e azioni di monitoraggio da promuovere con le scuole superiori locali con percorsi di alternanza scuola/lavoro.

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Reproductive phenology and health management of *Lepus corsicanus* raised in the Wildlife Center of Bieri, Corpo Forestale dello Stato

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The Italian Hare (*Lepus corsicanus*) is a rare and exclusive species typical of Central and Southern Italy and it is the subject of a specific National Action Plan developed by ISPRA. A survey on Italian hare's DNA showed the existence of three different haplotypes, which originated from three distinct geographic areas: Central Italy, Southern Italy and Sicily. One of the aims of the Plan it is to set up wildlife areas, where breed genetically checked subjects, that can be used them to reintroduce the species and to study the physiology, behaviour and health management of the Italian hare. Particularly, it is necessary to improve the knowledge of the species' reproductive biology, which is still lacking. The Corpo Forestale dello Stato manages Bieri Wildlife Centre (LU), now Wildlife Centre for the *ex situ* conservation of the Italian Hare; the Centre is at an altitude of 300 metres above see level, at the foots of the Tuscan-Emilian Apennines, it consists in a series of enclosures which are grassed over and protected from terrestrial predators, measuring between 400 and 1000 square metres.

The breeding was set up starting with 10 hares (2012) of the Central Italian haplotype, coming either from captures (N.R. Castelporziano) or from breeding areas (Wildlife Centre on Marturanum Regional Park, Wildlife Centre of Grosseto provincial administration). The breeders are reared on the ground forming small groups ofha male and a couple of females for each enclosure. The young hares never stay in the same enclosure more than 6 months, while the breeder spend the winter months in a specific box. The diet is composed by polyphytic grasses cultivated or of spontaneous meadows inside the enclosures, supplemented with pellet for maintenance, apples and carrots. Routine qualitative and quantitative faeces assays are carried out to check the presence of parasites; when the threshold (10000 oocyst/g and 400 eggs/g) it is exceeded, the animals are treated with anticoccidials and anthelmintic drugs, generally put into fruit. In 2015 the animals underwent an average of 3.6 treatments with anticoccidials and 1.6 treatments with anthelmintic drugs. Among the coccidia *E. bailei*, *E. deharoi*, *E. babatica* were detected, while the helminth which was identified belong to genus *Trycstrongilylus* spp., and less often to genus *Trichuris* spp.

The hares are vaccinated against EBHSv at weaning (40–45 days), undergo two injections with an interval of 3 weeks, and then every year. From 2012 to 2015, a total amount of 80 hares were born (verified), with a medium number of 2.5 leveret each female/year (minimum 1 max 6), divided into two or three litters. This parameter it is in line with what reported in literature (3 leveret/female) assessing the uterine scars in wild hare population. The sex ratio in the new born hares in 2015 is in favour of males (15M/11F). Birth's phenology shows a major concentration during late spring with a pick in July. The early births were in February while the latest were in October, with a reproductive diapause during the winter months. This is in contrast with what observed in the wild where the presence of pregnant hares and births was verified all the year long. The death rate in the 2015 was 10.7, mainly due to predation, trauma and rarely to parasitical and bacteric diseases. Fifteen young hares were used for reintroduction purposes on the Island of Elba during 2015 and the first results confirm the importance of the Bieri Wildlife Centre aimed at *Lepus corsicanus* conservation.

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Genetic identity of sicilian grey wolf *Canis lupus*

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The grey wolf *Canis lupus* was extinct in Sicily in the early decades of the twentieth century. There is no unanimity on the certain date of the last wolf shot (the species was considered to be "harmful" and therefore persecuted by any means). The last ascertained capture refers to a specimen shot down in Bellolampo (PA) in 1924, although there are reports of some other wolves probably killed in 1935–38 in the mountains around Palermo.
In past the species was widespread all over the island, especially over the mountains around Palermo, the woods of Etna, Peloritani Mts., Nebrodi Mts., Le Madonie, Sicani Mts., and Ficuzza Wood. It was also present further south, on Erei Mts., and Iblei Mts., where it seems to have been recorded until 1928.
To date, the remains of grey wolf of Sicily are extremely scarce: no more than 7 samples (skins, stuffed specimens, skulls, etc.) preserved in the Municipal Museum of Terrasini (PA), in the Museum of Zoology of the University of Palermo "P. Doderlein", and in the Museum of Natural History, Section of Zoology, University of Florence "La Specola". Among them, few complete specimens seemingly show peculiar characteristics respect to Apennine grey wolf (*Canis lupus italicus*) i.e. the grey wolf widespread along Italian peninsula. Among which the small size and the paler coat colour, although the elapsed time and the dust could have contributed to fade the subjects.
The purpose of this report is to try to reconstruct the actual identity of the wolf of Sicily that, despite its morphological differences and its isolation in respect to the continental populations of grey wolf, it has never been much studied nor historically, morphologically, and genetically. In the latter case for the difficulty of extracting DNA from ancient and contaminated samples.
Genomic DNA was extracted from hairs and skin fragments from five museum specimens using the QIAgen DNAeasy® Tissue Kit. The age of the specimens range ca 130–90 years old. Three different pairs of primers was used to amplify three overlapping fragment of the mitochondrial control region (235 bp, 150 bp and 57 bp). Sequencing reactions were run under BigDye™ Terminator cycling conditions by a commercial company, Macrogen (`www.macrogen.com`).
Obtained sequences were aligned with control region haplotypes from grey wolves belonging to peninsular Italy and other European, and North African localities. A statistical parsimony network was constructed, under 95% probability connection limits using the software TCS v. 1.21, highlighting the relationships of the Sicilian wolf populations.

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The return of the wolf (*Canis lupus italicus*) in the coastal area of Rome: research and management problems in a periurban context

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The natural return of the wolf (*Canis lupus italicus*) in the coastal area of Rome is a remarkable ecological, social and cultural event. Therefore it should be monitored, aiming to understand the process of the species recolonization that is particularly interesting in a context that evolved without the presence of this predator during the last century. After the first reports of the wolf presence in June 2013, we organized a volunteer research team and we defined a research protocol in order to estimate the size and the distribution of the wolf population in the Oasi LIPU Castel di Guido and in neighboring areas of the Riserva Naturale Statale del Litorale Romano. Moreover we aimed to evaluate the problems caused by a predator return in an agricultural area with widespread livestock activities. We identified sampling areas and we defined the routes that would be regularly combed over time. In the field activity we integrated two complementary monitoring techniques: a non-invasive genetic sampling, through collection of biological samples (faeces), analyzed by Istituto Zooprofilattico Sperimentale di Lazio e Toscana, and an opportunistic camera trapping sampling. The surveys, from June 2013 to date, allowed to take pictures and videos and to sample the DNA of three wolves (two males and one female) in different periods. The presence of several individuals during these years confirms the critical importance of monitoring, considering also to the probable establishment of a breeding pair in the next future. The genetic analysis on faecal samples identified the presence of an introgressed individual: the female sampled in September 2015 was a hybrid up to the 2nd backcross generation. Hybridization between wild species and their domestic counterparts may represent a threat to natural populations, with risk of loss of genetic identity for wolf populations. The camera trapping method confirmed the stable presence of the species in the area and it also allowed to record numerous free-ranging dogs. Their widespread presence represents a problem that involve several aspects of the wolf conservation, as the risk of hybridization, the increase of wolf-livestock social conflict and the spatial and trophic resource competition. Indeed we found several events involving free-ranging dogs, i.e. nine episodes of livestock depredation and an episode of wild boar consumption. Therefore the wolf recolonization of the coastal area of Rome is in progress, as demonstrated by the permanent presence of solitary individuals from June 2013 to date. The critical role of this area as a dispersal corridor and as a recolonization area should be closely monitored in the next future, in a perspective both of the species conservation and of a future coexistence with livestock activities.

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Presence of the grey squirrel in Umbria: a first assessment of abundance and distribution

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The population of the invasive alien grey squirrel (*Sciurus carolinensis*) in Umbria originated from the accidental release, in the early 2000s, of some individuals in the North Western suburb of the city of Perugia. Since then, the species spread up to a range of at least 50 km^2, mainly overlapped with urban and suburban areas of Perugia. The first aim of the LIFE U-SAVEREDS Project were (1) to estimate the distribution and density of this population, which represents a threat for the conservation of the local red squirrel (*Sciurus vulgaris*) population, and (2) to verify its further expansion in the surroundings of Perugia.

First of all, previous data about the presence of the grey squirrel were used to assess, through a kernel estimator, areas with different probably to encounter it. The area that cumulates the 50% of probability was assumed to be the core area of the population range (3.4 km^2). For monitoring and management purposes, the kernel range and the neighboring areas were then subdivided in Management Units (MUs), defined as homogenous zones from both anthropic and natural points of view. Observations from points of sighting (point transect method) were conducted in 16 MUs (a total of 13.5 km^2, 55% of the 95% kernel range), adopting a distance sampling methodology. The minimum number of individuals present in the surveyed region was obtained correcting the rough counts by animal detectability. Second, a monitoring protocol based on an adaptive, iterative sampling strategy was established to verify the presence of the alien grey squirrel in new areas. A random sample of MUs neighboring the actual grey squirrel range (primary MUs) was surveyed via direct observation of the animals or by camera-trapping, and then secondary MUs were surveyed only if adjacent to primary MUs in which the species was actually detected.

In the 16 MUs surveyed within the known squirrel range, a total of 209 squirrel sightings were recorded, of which only 25 referred to red squirrels. The latter were detected in 6 MUs, and most of their sightings were recorded in a MU at the margins of the grey squirrel range. Due to the few sightings of this species, we could only obtain an overall estimate of 112 red squirrels for the 16 MUs. On the contrary, the grey squirrel presence was detected in most MUs, and the minimum number of alien squirrels estimated for the 16 MUs was 1510. More than 40% (627) of these animals were located in 4 MUs (2.8 km^2), roughly corresponding to the 50% kernel core area. Also, the adaptive sampling protocol adopted to detect the expansion of grey squirrel allowed to verify the presence of the species in new, peripheral MUs located North-East of the Perugia city.

The survey activities carried out within the framework of the LIFE U-SAVEREDS Project allowed to collect fundamental data on the abundance and distribution of squirrels in the Perugia area. Results confirm that, in 15 years since its first report in Central Italy, the alien species already had a relevant impact on the indigenous one.

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Recent expansion of *Sciurus meridionalis* Lucifero, 1907 in Basilicata (southern Italy)

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The red squirrel *Sciurus vulgaris* Linnaeus, 1758 is the only European native arboreal squirrel and its distribution is strictly related to the forests and woodlands.

The Italian populations is ascribed to three subspecies: *S. v. fuscoater* occurring in the Alps and in the northern Apennines, *S. v. italicus* endemic to the Central Italy and *S. v. meridionalis* endemic to the extreme southern Apennines (Calabria) and isolated from other populations. In fact, the red squirrel currently occurs in the whole of the Italian Peninsula, but some distribution gaps occur: the species does not currently present in Apulia Region and is only marginally present in Campania and Basilicata Regions.

However, some morphological and remarkable genetic differences, substantiate the hypothesis that *S. vulgaris meridionalis* in Calabria is a distinct species if compared with all other European populations.

The range of *S. meridionalis* includes the four main mountain blocks of Calabria Region (the species has not been reported from the Serre Massif): the whole Pollino Massif (including the Lucania side), the Sila Massif, the Catena Costiera Mountains, the Aspromonte Massif. Yet the species is currently expanding its range toward areas where it was not previously recorded (i.e., the recent colonization of the Catena Costiera Mountains).

So far *S. meridionalis* had been detected only in two places, situated in the Regional Park of Gallipoli-Cognato, in the central area of the region, beyond its historical habitat in Basilicata represented by the Pollino National Park.

To describe this expansion process even in the Basilicata, we report the occasional sightings by locals, validated by photos, and field research within sample areas.

Our data suggest its expansion toward areas where it was not previously seen. The new records of *S. meridionalis* are widely distributed in the Southern and Central part of Basilicata and are geographically connected with the Western and Northern side of the Pollino.

Although, also if it is preliminary sightings correlated to some events that are happening, our data suggest an expansion of *S. meridionalis* toward the West Coastline Mountains and the North of Basilicata, with colonization of the Appennino Lucano National Park. With regard to ecological preferences, the Regional forestry map and 1st level physiognomic categories show an association of *S. meridionalis* with mesophilic and termo-mesophilic oaks (45%), other non-coniferous mesophilic and termo-mesophilic species (20%), oro-mediterranean pine forests and other mountain and sub-mountain conifers (14%), hygrophilous formations (7%), Mediterranean Pine woods (3.5%), beech woods (3.5%), wood plantations and other exotic plantations (3.5%).

The presence of an expanding nucleus of the alien squirrel *Callosciurus finlaysonii* in the west coast of Basilicata Region and southern Campania Region may be a significant threat for this endemic species and hinder its possible expansion toward the North.

Further and more detailed research is in progress whit the aim to better understand and investigate and validate the presence of stable populations in this region.

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Seasonal Spatial behaviour of pine marten *Martes martes* in a deciduous oak forest of central Italy

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Size and characteristics of home range are fundamental ecological parameters for a species and useful life-history variables for predicting the number of individuals that can occupy a data area. In Italy, wildlife biologists have largely ignored spatial ecology of the European pine marten, although this predator is present with a fragmented distribution across the peninsula. This study investigates the seasonal socio-spatial ecology of this species in a sub-Mediterranean deciduous oak forest of central Italy, by radio-tracking 16 pine martens (eight males and eight females). Size, composition and stability of seasonal ranges (FK 95% and 50%) were analysed in both sexes, as well as intersexual and intra-sexual seasonal territoriality. Unlike what has been reported in literature for other European habitats, home ranges resulted similar in size and forest coverage for both sexes and throughout seasons. The only exception where females' territories whose size decreased in spring. Males and females occupied ranges stable in both position and size through the year, leading us to suppose that the sub-Mediterranean deciduous oak forest was able to meet resource requirements for both sexes and in all seasons. The spatial distribution of neighbour individuals was different from what expected from the social organization of the species, with males revealing intra-sexual exclusivity only in core areas, and female pairs showing higher overlap and proximity of ranges than intersexual pairs. The intra-sexual overlap between home ranges was higher than that reported in other studies on pine marten, according to what expected in a habitat where resources are not limiting and marten population is high-density. Surprisingly males and females also avoided one another during the summer mating season, suggesting a possible influence of other factors in recorded socio-spatial behaviours. However we do not exclude that the low number of simultaneously monitored individuals biased our results. We chose to carry out the study at seasonal scale, taking into account the reproductive cycle of the species, even though analysing at a smaller scale implies having a smaller sample size. We stress that further studies with larger sample size are needed to generalise and validate our findings. Nonetheless, our research provides useful information on the socio-spatial ecology of the European pine marten in a sub-Mediterranean deciduous oak forest and may be helpful for the conservation management of this species in Italy.

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Qualità del pascolo e comportamento sociale nel camoscio appenninico

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I cambiamenti climatici in atto agiscono con maggiore intensità negli ambienti estremi o caratterizzati da una forte stagionalità, per es. gli ambienti di montagna. La diminuzione delle risorse causata dal cambiamento climatico può aumentare la competizione, sia a livello interspecifico che intraspecifico. Negli ultimi 30 anni, nel suo areale storico del Parco Nazionale d'Abruzzo, Lazio e Molise (PNALM), il numero di camosci appenninici *Rupicapra pyrenaica ornata* è diminuito di circa il 50%. Condivide parzialmente il proprio habitat con una popolazione reintrodotta di cervo *Cervus elaphus* (oggi abbondante: 1972–1985, 81 individui rilasciati; 2010, c. 2500 individui). Recenti studi condotti nel PNALM hanno mostrato come la presenza del cervo ad alte densità limiti indirettamente il camoscio, contribuendo a provocare (a) una minore sopravvivenza dei piccoli; (b) una ridotta qualità della dieta del camoscio a causa del sovrappascolo e del calpestio; (c) una minore efficienza di pascolo degli individui adulti. Le informazioni su possibili effetti della diminuzione di risorse sul comportamento sociale (per es. aumento della competizione intraspecifica) sono scarse. Mediante osservazioni comportamentali (luglio-ottobre 2014/2015) abbiamo esaminato il comportamento aggressivo e di vigilanza nelle femmine di camoscio, in tre aree con diversa qualità del pascolo, per verificare se la scarsità di risorse possa influire sullo "stress" sociale. Nelle due aree più povere, caratterizzate da temperature estive ed autunnali più alte e dalla presenza del cervo, abbiamo osservato (a) una significativa maggiore frequenza di manifestazioni di aggressività tra le femmine e verso i piccoli; (b) una significativa maggiore frequenza e durata del comportamento di vigilanza. Questi risultati suggeriscono una più elevata competizione intraspecifica ed un maggiore stress nelle aree in cui le risorse sono di scarsa qualità. Se l'attuale cambiamento climatico è all'origine dell'impoverimento della vegetazione pascolata dagli ungulati di montagna, in tempi medio-lunghi ci possiamo attendere una locale conseguente crescita di stress a livello intra-gruppo, soprattutto nelle aree frequentate anche da competitori ecologici come il cervo.

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Evoluzione temporale del comportamento sociale nel camoscio appenninico

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La stagionalità delle risorse è un fattore cruciale negli ecosistemi montani, dove le risorse alimentari sono molto più abbondanti nei mesi estivo-autunnali, fin quasi a scomparire durante l'inverno. Le risorse di elevata qualità sono concentrate nella breve stagione vegetativa (giugno-luglio). In questa parte dell'anno, l'accesso a un pascolo con alto contenuto di nutrienti è fondamentale per gli ungulati, soprattutto nelle classi giovanili di età, nelle quali l'accumulo estivo di riserve energetiche determina la sopravvivenza invernale. Per le femmine, l'allattamento e lo svezzamento dei piccoli comportano un costo energetico particolarmente elevato. Nel Parco Nazionale d'Abruzzo, Lazio e Molise (PNALM) le femmine di camoscio appenninico *Rupicapra pyrenaica ornata* vivono durante tutto l'anno (ad eccezione degli accoppiamenti, in novembre) in gruppi unisessuali, insieme a individui di ambo i sessi di età 2 anni, nelle praterie d'altitudine. La quantità e qualità delle associazioni vegetali selezionate dal camoscio sono massime all'inizio dell'estate, diminuendo in autunno, quando il pascolo si concentra sulle foglie di leguminose, le sole a mantenersi ricche di proteine e sali minerali anche dopo il periodo vegetativo. Abbiamo esaminato alcuni aspetti del comportamento sociale delle femmine di camoscio durante i mesi cruciali dell'allattamento/svezzamento (luglio-ottobre), per verificarne la relazione con il gradiente temporale di qualità del pascolo. Abbiamo osservato (a) un aumento dell'attività in settembre-ottobre, al diminuire delle ore di luce; (b) una diminuzione della frequenza, contemporaneamente ad una maggiore intensità, di manifestazioni di aggressività tra le femmine, e un aumento di intolleranza verso i piccoli, da luglio a ottobre; (c) un decremento della vigilanza durante il periodo di studio. La competizione per le risorse influenza il comportamento sociale del camoscio. Per soddisfare le proprie esigenze nutritive, le femmine aumentano l'attività al diminuire delle ore di luce a disposizione per il pascolo. Nel periodo di studio, ad una diminuzione di frequenza, corrisponde un aumento di intensità di manifestazioni aggressive. A inizio estate esiste una maggiore eterogeneità di risorse alimentari, pertanto è probabile che la maggiore frequenza di eventi aggressivi dipenda dalla competizione per quelle migliori. L'intensità dell'aggressività cresce invece in autunno, prima dei rigori invernali, quando la disponibilità delle migliori risorse alimentari si è ridotta alle foglie di leguminose. L'intolleranza verso i piccoli si sviluppa alla fine del periodo di allattamento, quando al termine dello svezzamento anche i camoscetti diventano potenziali competitori di pascolo ed è importante per le femmine affrontare nelle migliori condizioni fisiche la nuova gravidanza, durante i rigori invernali. Tre fattori potrebbero essere coinvolti nel livello di vigilanza durante il periodo di studio: i) l'afflusso turistico, che raggiunge un massimo in agosto, al quale corrisponde un picco della frequenza di allarmismo nei branchi di femmine; ii) la vulnerabilità dei nuovi nati, che rende le femmine più vigili a inizio estate; iii) la maggiore frequenza di interazioni aggressive, che causa nelle femmine un maggiore grado di allarmismo in luglio-agosto.

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Tentativo di predazione di un lupo sul camoscio appenninico

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Negli erbivori, la predazione ha selezionato un gran numero di strategie difensive, molte delle quali risultano vantaggiose in presenza di conspecifici, per es. il comportamento di vigilanza e di fuga. In una stessa specie, il comportamento antipredatorio può variare a seconda di diversi fattori, come la struttura del gruppo, l'età, il sesso, l'habitat e il tipo di predatore. Tra gli ungulati di montagna, la principale reazione ai predatori terrestri è la fuga in pendii rocciosi e ad elevata pendenza. Tuttavia, la documentazione di interazioni tra predatori e ungulati in ambiente montano, con l'analisi delle relative risposte antipredatorie, sono scarse in letteratura. Abbiamo descritto il comportamento antipredatorio esibito da un gruppo di camosci appenninici *Rupicapra pyrenaica ornata* al pascolo, a seguito di un attacco di un lupo *Canis lupus* - probabilmente una giovane femmina, nel Parco Nazionale d'Abruzzo, Lazio e Molise (PNALM). Abbiamo confrontato il comportamento aggressivo, la vigilanza e l'attività delle femmine di camoscio prima e dopo l'attacco. I camosci hanno mostrato un chiaro *pattern* di fuga durante l'attacco: alla vista del predatore, le femmine, i maschi e gli *yearling* sono scattati, in coordinazione, verso tre direzioni opposte. Gli *yearling* hanno scalato un ghiaione, rifugiandosi sulla cima della montagna. Le femmine sono fuggite in un'area di pascolo più ripida ed elevata, vicino alla cresta montuosa. Al contrario, i maschi si sono diretti verso il bosco sottostante la vallata, probabilmente in cerca di un nascondiglio tra la vegetazione. Il lupo ha inseguito gli *yearling* sul ghiaione, abbandonando l'attacco a circa 15 m da essi, scomparendo successivamente dalla nostra vista. Dopo il tentativo di predazione, le femmine di camoscio hanno trascorso più tempo in vigilanza, mentre l'attività e il comportamento aggressivo non sono risultati significativamente diversi. La zona di rifugio è apparsa dipendere da sesso/età dei camosci. Gli *yearling*, più vulnerabili, si sono rifugiati in un'area a massima pendenza e copertura rocciosa. Le femmine e i maschi sono fuggiti rispettivamente in aree più e meno elevate, in accordo con la segregazione sessuale dell'habitat tipicamente osservata nella specie. Sebbene il lupo abbia probabilmente abbandonato l'attacco per via dello sfavorevole ambiente di caccia (ovvero, a causa dell'elevata pendenza e dal terreno instabile del ghiaione), un deterrente importante potrebbe essere rappresentato dalla fuga in dispersione effettuata dai camosci. Questa strategia potrebbe aver "confuso" il predatore, suggerendo un elevato livello di cooperazione, già documentato in caso di attacchi da parte di predatori alati diretti verso i piccoli, in un ungulato altamente sociale come il camoscio. Il lupo inoltre, massimizza la predazione spesso cacciando in branco. L'aumento della vigilanza da parte delle femmine di camoscio dopo il tentativo di attacco potrebbe essere dovuto ad una maggiore percezione del rischio di predazione, per es. la potenziale presenza di altri individui nelle vicinanze.

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The diet of the red fox in Alpine ecosystems – Gran Paradiso National Park

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Scat analysis is a largely used non-invasive method to study carnivores' diet, and in particular to investigate red fox ecology. Faeces are generally easy to find in the field, allowing for homogeneous samplings in different habitats, without any direct animal manipulation.

The food habits of the red fox in the Gran Paradiso National Park (GPNP) have been studied since the 1950s with this method, in order to describe which food resources are exploited by this species in the alpine ecosystems.

In the last decades some changes occurred in the faunal composition of the Park: roe deer and wild boar showed a rapid expansion of their populations, together with the wolf re-colonization of this alpine area. The availability of historical data about the feeding ecology of the red fox gives the opportunity to identify possible time-scale variations in the food habits of this carnivore, produced by the recent changes in prey availability and possible competitive interactions. Therefore, this study investigates the diet ecology of the red fox in the sector mainly interested by the changes in faunal composition in the GPNP, the Soana Valley, in order to compare the results with those obtained in the previous studies carried out in this area.

The characterization of the red fox diet in the Soana Valley required the analysis of 1014 faecal samples, collected between July 2014 and July 2015. We identified a significant seasonal variation in food resources exploitation, with a narrower niche breadth in the cold season. Indeed, in winter the red fox diet was based mainly on ungulates, while in the warm season this species is able to feed on a larger range of food categories (small mammals, fruits, insects etc.).

The results provided in this study are very similar to those reported in the previous researches in the GPNP. However, we identified some differences, mainly related to the variation in prey availability.

The most important difference is the presence in the red fox diet of roe deer and wild boar, recently spread in the Park. Nevertheless, despite these new food resources, the exploitation of the alpine chamois as food by this canid seems to be unvaried compared with the previous studies, indicating a relative low consumption of roe deer and wild boar. These results could reflect the presence of a low number of individuals of these ungulates in Val Soana, but could also be the consequence of an ecological interaction between the red fox and the wolf. Indeed, some authors demonstrated that the latter feeds mainly on cervids in the Western Italian Alps, showing lower predation rates on the alpine chamois.

In the next months our research should continue, analyzing ungulates density data for the GPNP area. This analysis could provide an estimate of the effective prey availability for the red fox in the study area, helping us to formulate a correct interpretation of the results described in this poster.

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La colonia di ferro di cavallo maggiore (*Rhinolophus ferrumequinum*) e vespertilio smarginato (*Myotis emarginatus*) del campanile della chiesa di San Francesco ad Acquapendente (Viterbo, Italia). Una convivenza possibile?

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Il personale della Riserva Monte Rufeno ormai da diversi anni effettua il controllo dei siti di presenza dei Chirotteri nel territorio dell'area protetta e nelle zone limitrofe, individuando i rifugi di svernamento e/o riproduzione delle specie che necessitano di maggiore protezione e tutela. In questo ambito, a partire dal 2009 è stata rilevata la presenza di una importantissima colonia di Chirotteri all'interno del locale di accesso alle scale del campanile della Chiesa di S. Francesco nel comune di Acquapendente (Viterbo, Italia). Si tratta di una nursery in cui sono stati osservati fin dal primo anno diverse centinaia di individui appartenenti alle specie Ferro di cavallo maggiore (*Rhinolophus ferrumequinum*) e Vespertilio smarginato (*Myotis emarginatus*). Dalla prima stima effettuata nel 2009 tramite analisi del materiale fotografico sono risultati almeno 800 individui. La colonia è stata segnalata ai competenti uffici della Regione Lazio e valutata di importanza nazionale per consistenza e specie presenti. La sua collocazione nel cuore del centro storico della città si è rivelata in breve tempo una vera e propria sfida per rendere reale e concreta la convivenza tra uomini e specie selvatiche. Infatti è stato necessario negli anni successivi monitorare ed affrontare diverse problematiche legate alla possibilità di conciliare le esigenze dei Chirotteri, che hanno scelto il locale del campanile per una delle fasi più delicate del loro ciclo vitale, e lo svolgimento di pratiche religiose e consuetudini che legano il campanile alla cittadinanza. Questo compito complesso è stato affidato al personale della Riserva, chiamato in primo luogo a sorvegliare l'integrità della colonia, e, nel corso degli anni, ad occuparsi anche della promozione di iniziative e attività di informazione e sensibilizzazione finalizzate alla valorizzazione della colonia come bene della cittadinanza di Acquapendente. Sono stati organizzati incontri, convegni, *bat night* e attività con le scuole locali e con il Museo del Fiore, struttura dedicata alla diffusione della cultura naturalistica e della sostenibilità presente nel territorio dell'area protetta, ma ancora molto lavoro va fatto per superare la radicata diffidenza verso i Chirotteri. Una delle sfide più difficili è stata quella di affrontare, nel 2011, i lavori di recupero e consolidamento del campanile, che grazie a un lavoro di *governance* svolto con l'importante supporto della Direzione Ambiente e l'Agenzia Regionale Parchi della Regione Lazio, sono stati realizzati rispettando le esigenze ecologiche della colonia presente. A partire da quella stagione, in cui è stato necessario monitorare in modo continuo e sistematico le variazioni di consistenza della colonia, il personale della Riserva Monte Rufeno ha continuato ad effettuare il controllo ogni estate da giugno a fine settembre, dal 2011 al 2015, con cadenza da settimanale a quindicinale. Il metodo utilizzato è stato quello del conteggio diretto degli individui in fase di emergenza dal rifugio, effettuato con almeno 2 operatori vista l'ampiezza dell'uscita dal *roost*, che è stata quindi suddivisa in due settori spaziali. In questo modo è stato possibile verificare l'arrivo e la partenza degli individui dalla nursery, le variazioni di consistenza della colonia da giugno a settembre, l'avvenuta riproduzione e l'effetto di eventuali fattori di minaccia. Per ogni sessione di conteggio sono stati annotati anche l'ora dei *light sampling* e poi di effettiva uscita dal rifugio, le condizioni meteo e la presenza di eventuali predatori (sono stati osservati in diverse occasioni un lodolaio e una civetta in volo circolare o posati in prossimità dell'area di uscita dei Chirotteri). La consistenza della colonia è risultata relativamente costante negli anni, con una media di adulti, conteggiati nelle diverse stagioni di monitoraggio durante il periodo tra fine giugno e i primi di luglio, corrispondente a 752 individui. Un'importante eccezione è rappresentata dai dati del 2012 quando, per motivi ancora non definiti, è stata registrata nello stesso periodo giugno-luglio una presenza di soli 172 individui adulti. Tale "anomalia" non è stata considerata per il calcolo della dimensione media della colonia. I dati raccolti nel corso di questi anni vengono presentati come ulteriore stimolo per la comunità tutta, fatta di amministratori, esperti e cittadini, a realizzare davvero quella che deve diventare sempre di più una "convivenza possibile".

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Bat roosts in Monte Rufeno Nature Reserve (Acquapendente, Viterbo, Italy)

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All bat species are considered of high conservation importance at European Union level, since they are included in the Habitats Directive 92/43/CEE Annex IV, so a strict protection regime must be applied across their entire natural range. In Italy, the D.P.R. 357/97 implementing the Directive, states that Regions and protected areas must ensure monitoring and maintenance of natural habitats and species of Community interest at a favourable conservation status, also according to recent laws referred to environmental damage (art. 1 D.Lgs. 121/2011, art. 733bis of Penal Code) which order to avoid any alteration of species habitats. Monitoring of bat presence sites is an activity carried out routinely by Monte Rufeno Nature Reserve staff since several years, even though on the basis of a standardize protocol only since 2006. The main purpose of such monitoring is to obtain as many data as possible about bat populations living in the Nature Reserve territory and in bordering Sites of Community Importance: specifically reproduction sites are located and georeferenced, data are collected concerning abundance of nurseries, their distribution throughout the monitored area and concerning occupied habitats. Moreover, every year potential threats are detected and consequently specific conservation actions are planned. Species mainly examined are *Rhinolophus hipposideros* and *Plecotus auritus*, due to the localization of nurseries inside several old farmhouses in the Nature Reserve territory. Distribution and abundance of these nurseries are here presented, correlated to specific key factors, such as available surface inside roosts, land use and proximity of water sources. Data collected from 2010 to 2015 show that most of *Rhinolophus hipposideros* nurseries are located inside small facilities close to farmhouses. More in detail, farmhouse called Felceto hosts every year inside its old pigsty a colony displaying an average of 25 adults; inside boiler room of farmhouse called Tigna are counted an average of 26 adults, finally in the garret of a facility close to Marzapalo farmhouse, since the last 6 years a colony constituted by an average of 92 adults is monitored. Regarding *Plecotus auritus*, only one colony is known, which often uses available space between walls and window shutters of Monaldesca farmhouse (during the last 2 years bats inhabit also the 3 bat boxes arranged on the farmhouse walls). This colony is very difficult to control, because bats very often "switch" from one roost to another throughout the summer season. The average number of adults counted in this colony during the last 6 years is 33. All farmhouses hosting a roost are close to old stone troughs and are surrounded by woods. During every reproductive season at least 2 samples for each colony are implemented between the end of May and the middle of July, in order to count separately adults from young individuals and, later on, to confirm the reproduction success.

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Monitoring program of wolf (*Canis lupus*) in the areas of Natural Reserve of Laghi Lungo and Ripasottile and in the mountain of Rieti, first data on location and size of family groups in autumn/winter 2015/2016

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The historical presence of the wolf (*Canis lupus*) in the inland areas of the province of Rieti has never failed, even at the end of the sixties, when at national level, the species was at risk of extinction. The vicissitudes of human dimension, such as the incentive of hunting with the aim of eradicating (nineteenth century), the impact on livestock (and the numerous attempts of fraud), the increase of poaching and the increased conflict with the hunters (due to the supposed and partly actual predations of wild boar, and the restart of the illegal and unjustified persecution), have been thoroughly studied in some areas of the province. With regard to population dynamics, reproductive success and land use have information related to some territories of the province. This five-year (2015–2019) project aims to combine and rationalize into a single program involving large part of those who for various reasons were already conducting investigations on wolf in the province of Rieti, standardizing techniques, procedures and timing. The study area covers 980 km^2 and is diversified both from land cover (about 490 km^2 are covered by deciduous and mixed forests, coniferous forests cover about 13 km^2) and administrative point of view (includes 36 municipalities of 3 provinces). The altitudinal gradient is between 370 and 2200 m asl. The urbanized areas consist of 15 ha, and 5 km^2 are the discontinuous urban areas. The populated areas are concentrated in some of the sectors investigated. The road network consists of 1 km of highway, 142 km of provincial roads and 167 km of national roads. Large areas are completely uninhabited and in part are seasonally used for pasture, traditionally implemented in the "pastures" with free range or extensive techniques. The monitoring program was conducted by the application of the following techniques: transects (n. 27, for a total of 86 km), scat analysis (for the first time collected in the study area), Snow-Tracking (performed opportunistically in relation to the presence of snow), camera trapping (applied in synergy with the tracking of snow to check the size of family groups and reproductive success), Wolf-Howling (conducted in late fall/winter and post reproductive age according to the most widely adopted standard in the investigation carried out at national and international level). Recorded vocalizations are emitted in 106 stations. In each field session are simultaneously engaged 31 workers, divided into 13 teams which investigate nine sub-areas of investigation: Reserve of of Laghi Lungo e Ripasottile and surrounding areas, the massif of Terminillo, the areas close to the Gran Sasso and Monti della Laga, area of Mount Pozzoni, average Velino valley, low Velino valley, the right bank of the river Salto area, the left bank of the river Salto, offshoots Southeast Cicolano behind the Natural Reserve of the Duchessa Mountains. The survey conducted allow to identify 9 family groups, with a density of 0.98 family groups/100 km^2. This result was higher than that estimated in 2014 for the entire Apennine area, where the density was about 0.70 family/100 km^2 in protected areas, and 0.53 family/100 km^2 in unprotected areas. The distribution of family groups falls substantially along the main direction of expansion of the distribution of red deer, especially coming spontaneously from the reintroduction areas of Mount Velino and that, along with the wild boar and roe deer, is one of the potential wild food resources for wolves. Roe deer, monitored in certain limited areas, is estimated in constant increase. The presence of wolf family groups are in agreement with the presence of wild boar hunting areas and hunting bags. These data confirm wild boar is the most relevant food source for the wolf, as also demonstrated in large part of the studies conducted at the national level. The livestock systems adopted in the area under investigation support the hypothesis that livestock represent a not negligible food resource. In fact, traditionally, sheep are kept during grazing and confined in fenced areas at night, while large animals are kept in the wild only during 4–5 months for pastures. The scat analysis can give an answer to these hypotheses. The camera trapping, applied opportunistically, made it possible to detect two family groups consisting of 6 to 8 individuals; 3 family groups intercepted by Wolf-Howling results particularly numerous, not allowing the exact number to be estimated.

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Abundance and dynamics of stray dog population in the area of Natural Reserve Laghi Lungo e Ripasottile (Province of Rieti), update 2015

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Twenty-five years after the enactment of the Law 14 August 1991 n. 281, in Italy the protection of animals and the reduction of the phenomenon of stray dogs should be consolidated. According to the legislation, "*the State promotes and regulates the protection of pets, condemns the acts of cruelty against them, ill-treatment and their abandonment in order to facilitate the proper coexistence between humans and animals and to protect public health and the environment*". The enactment of this legislation was an important step by the ethical and cultural point of views which, however, still does not seem to be completely acquired by peoples. In addition to recognizing the right to life to pet animals, the law prohibits the removal of animals found wandering without owner on the land and prohibits the abandonment of pets. The burden of providing for the capture and care of stray dogs in public (structures not present in the province of Rieti) or private kennels (which are particularly expensive and do not always ensure compliance to legal standards) is entrusted to municipalities. A specific study conducted in 2011 in some small municipalities in the province of Rieti has shown that local governments do not have the resources to support such a charge (currently the average cost of keeping an animal in a kennel is about € 3.50/head/day, for an annual total of € 1250.00/head). Consequently, these organizations have no alternative to the "blind eye" the presence of stray dogs in their territories. So that the stray dogs continue to be a problem in many areas. A study on stray dogs conducted on the national basis in 1983 by the National Institute of Biology of the Game (now ISPRA) indicated that in the province of Rieti there was a density of stray dogs/km^2 equal to 1.62. To update this data, in the same territory a similar survey in 2012 revealed that the average density was 0.31 stray dogs/km^2. About 19% of observed stray dogs (alone or in groups) have taken place in natural areas (11% of these were single individuals, about 19% belonged to 66 groups mono/multi-racial. The sizes ranged from 2 to 5 subjects with a mean = 2.42, S.D.=±0.63, the average distance of observation by the nearest town was about 552 m, S.D.=±454.24). About 37% of the total subjects was fitted with the collar, while about 63% of it was lacking and they were considered stray. The same study revealed that the wrong management of the guarding dogs was a particular source of stray dogs. The main factors that produce stray dogs in the Natural Reserve Laghi Lungo e Ripasottile (RNLLR): the location of the area in the neighbors of Rieti, the presence of small villages in the district and several sparse houses, the presence of some wild boar hunting areas close to the protected area. The awareness that the presence of stray might affect negatively on zoocoenosis, meant that in 2014 the RNLLR activate a monitoring plan. The project performed under the scientific supervision of the University of Tuscia DAFNE of Viterbo. Monitoring is structured on the periodic execution of transects distributed over the entire surface of the protected area. The 11 transects have been appropriately identified for a total of 33 km. These routes have been georeferenced. The transects are performed with a frequency roughly fortnightly. In the field sessions will also write down the breeds of observed stray dogs, which were found to be only half-breeds, and herding. It was decided not to consider stray (not stray) the dogs with collar, which would suggest the existence of an owner. The permanent presence of some flocks in the protected area is the source of the presence of stray sheep dogs. In addition to describe the characteristics of the monitoring, which will run for five years (2014–2018), we present the first results from data acquired in 2014. Between mid-September 2014 and the middle of December 2015 were carried out a total of 24 sessions of detection. In each session were performed all 11 transects and all activities were carried out within the same day. They are altogether checked 129 stray dogs. From the quantitative point of view, on the same day they were intercepted by a minimum of 0 to a maximum of 11 subjects, the latter reaching events occurred in 2 separate occasions, with an average of 1.0 dogs/route (S.D.=±1.67) in one case, and an average of 1.0 person/route (S.D.=±2.49) in the second case. Overall, in the individual paths were observed by a minimum of 2 to a maximum of 29 subjects (mean 12.0; S.D.=±7.7). This shows that some sectors of RNLLR are more prone to the problem of stray dogs than others.

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Monitoring the consistency of Fox (*Vulpes vulpes*) in the Natural Reserve of Laghi Lungo e Ripasottile (Rieti): pre reproductive density

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For more than a decade in the province of Rieti the Fox (*Vulpes vulpes*) was monitored in the Territorial Areas Hunting Rieti1 and Rieti2 (ATC). The attention of these institutions is due to the fact that the carnivore is a potential predator of species of hunting interest. The Lazio Regional Law 17/1995 (Art. 29, paragraph a) reports that the ATC should adopt three-year administrative schedules including the annual update of the status of the species of interest, and therefore also of the fox. To this end, both ATC have adopted a similar detection system based on the Spot Light Census of sample areas which cover at least 10% of the area to be investigated. For this reason the population dynamics of the species are known in hunting areas and unknown in protected areas. Only in some cases episodic surveys on species were performed in protected areas. Prior to the drafting of the current three-year schedules, outside the Natural Reserve of Lakes Lungo and Ripasottile (RNLLR) the Fox underwent two specific numerical control programs. One made of 38 municipalities in ATC Rieti1 between 2005–2006 and 2009–2010, with a reduction of 2093 heads (average 18.52 heads/common; S.D.=$\pm$17.37); the other made 34 different areas of ATC Rieti2 between 2006 and 2009, with a reduction of 1108 (average 11.28 heads/common; S.D.=$\pm$10.64). Subsequently, in the process of preparing three-yearly schedules, both ATC have set the target density 1.5 units/km^2, both for hilly areas and mountain. So that, despite the considerable amount of removal, both ATC have established that the species is still numerically exuberant and in need of further containment. It is advised, also, that the RNLLR is completely flat and characterized by alternating cultivated areas, grazing meadows and riparian woodlands. In the area food sources of anthropogenic nature for Fox, as food waste and/or slaughter, are rare and occasional. It is in this general scenario that RNLLR considered it necessary to have to program and activate a suitable five-year plan of the carnivore monitoring consistency in its territory. In order to obtain comparable data with those of the ATC, also in the protected area of the Spot Light Census technique and the monitoring program applied provides that the detection sessions are systematically carried out in the pre reproductive periods, reproductive post, and subsequently to the eventual restocking activities carried out by ATC. Among the objectives of the monitoring, it is also to check whether there is migration of foxes to and from the RNLLR in conjunction with the repopulation of hunting species. Considering that the protected area covers approximately 3000 hectares, the applied detection technique imposes to inspect at least 10% of the area, and that the spotlights covers 75 m to each side, were georeferenced approximately 12.5 km of routes in a GIS environment. In this way the total inspected area during each detection session is approximately 317.6 hectares, equal to 10.6% of the entire protected area. The substantial homogeneity and geomorphology of the area investigated topsoil has simplified the choice of routes, which are sufficiently straight and fixed in areas where visibility from the off-road vehicle box body used in the field of sessions is optimal. To contain the timing of field activities and counting errors, it has been established the simultaneous operation of two patrols of detectors, so that each of them should go through only half of the total planned route. After some simulation sessions, designed to detect and solve any problems due to the tracks (if necessary adapting them to the vegetation cover) and to develop the equipment to be used, between 27.10.2015 and 01.10.2016 (pre reproductive age) 4 survey sessions have been conducted, allowing to estimate an average density of 5.36 fox/km^2 (S.D.=$\pm$12.26). The density of the species in areas outside the RNLLR, estimated in 2009 and 2011 by ATC Rieti2 Rieti1, was between 0.4 and 4.5 units/km^2. Since the density detected in the protected area is markedly higher than the estimated maximum fixed for the outside area, it is necessary to verify both the qualitative and quantitative aspects of the diet of the fox, the pressure of predation on the eggs, the chicks of bird species nesting on the ground and litters of other species, with particular attention to those of conservation concern.

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The hazel dormouse at the limit of its altitudinal range

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An important component of the ecological niche of a species is the altitudinal range where it is evolved to live. Knowing if a species is only adapted to lowlands or to mountains or if it is able to live at a wide altitudinal range, gives an idea of its ecological plasticity and, therefore, the possibility to cope with environmental changes. The hazel dormouse *Muscardinus avellanarius* is commonly considered as being typical of low altitudes. Single observations are known also in high mountains, but it is yet unclear whether it may reach alpine habitats with continuous populations. In this work, we evaluated the presence of this dormouse in the mountainous and subalpine mixed conifer forests up to the tree line in the Italian Alps.

We searched for hazel dormouse nests in Valsavarenche and Val di Rhemes (Northern Italy), characterized by a similar vegetation composition: deciduous woodland up to 1100 m, mixed woodlands up to 1400 m, conifer woodlands up to 1700–1800 m; over 1700–1800 m, Alpine prairies and screes become predominant. The edible dormouse *Glis glis* is present mainly at low altitudes and sporadically above 1400 m; the garden dormouse *Eliomys quercinus* was instead recorded in all coniferous habitats, up to the tree limit. Summer nests of the species were searched along the valley floors at progressively higher altitudes, in October-December 2015, when defoliation makes the detection of nests easier. At each site, woodland edges and shrubs areas were systematically searched for hazel dormouse summer nests.

During our survey, we detected for the first time a continuous presence of the hazel dormouse in subalpine mixed conifer forests, from 1600 m up to the tree line over 2032 m a.s.l, which represents the current altitudinal record for the species. Hazel dormouse nests were found at altitudes of 1600, 1689, 1864, 1874, 1923 m in Valsavarenche and at 1681, 1790, 1930, 1962, 2032 m in Val di Rhemes. All the nests were composed by layers of different vegetal matter (mainly leaves and fluff of *Epilobium* or large fibers outside and thin fibers, ferns, grass and moss inside), a structure which may promote cohibentation and facilitate thermal regulation in cold habitats.

Most of the shrub species identified within a 50 m radius around the nests bloom between May and July and fruits are available from July-August until at least late autumn, covering most of the activity period of the species. Bushes producing berries, such as *Vaccinium* spp., *Rosa* spp., *Berberis vulgaris*, *Rubus idaeus*, are common in the investigated areas and are good food sources for hazel dormice. However, some nesting places were characterized by a low diversity of tree and shrub species, with only 4 woody species not forming a continuous and dense shrublayer usually used by the species.

Results of this study show that the hazel dormouse is widely distributed in the subalpine altitudinal zone of the two investigated valleys, characterized by the presence of mixed conifers forests and shrublands. These areas represent the altitudinal limit of the species distributional range and are characterized by short summers and demanding climatic conditions. Therefore, studying the adaptation strategies of the hazel dormouse to such extreme conditions could help in understanding its ecological plasticity and in drawing addressed management plan for its conservation.

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Measuring hind-foot length with high resolution during field-work

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Estimating body conditions of live-trapped mammals usually requires collecting information on body mass and skeletal size. A ratio of body mass on a measure of structural body size provides a index of body condition which may be used to compare animals among sexes and age-classes or among areas. Skeletal size may be measured as total length, body length, hind-foot length; anyway, the measurement of the hind-foot length is easier to collect with respect to the previously reported ones. This measurement is usually carried out using a ruler or a similar tool, with a millimeter resolution. A similar resolution is acceptable in medium and large animals, but in small mammals, where the hind-foot is often few millimeters length, it may be not enough. We developed a system based on image analysis to evaluate the hind-foot length with a resolution of a tenth of a millimeter, easily applicable during the manipulation of small mammals in live-trapping studies. This system consisted of two phases. During the former, the hind-foot (without the nails) of each trapped individual was measured through a transparent ruler and photographed by leaning it on the ruler itself. In a second step, the picture shot on the field was enlarged up to one millimeter on the ruler as long as a centimeter of a graph paper and a tenths of a millimeter in the rule was equivalent to a millimeter of the graph paper. In this way, each real millimeter (as measured through the ruler) was divided into 10 tenths of a millimeter, allowing us a detailed measurement. We apply this measurement system during a research on small mammals conducted in the Gran Paradiso National Park. The hind-foot length of 76 *Eliomys quercinus*, 368 *Myodes glareolus* and 68 *Sorex antinorii* was measured firstly with a ruler (R) and then with the imagine analysis (IA). The accuracy of the two systems was evaluated considering the error with which the resolution of the method (1 or 0.1 mm) measure the length of the foot: resolution/hind-foot length measured with the method$\times$100. In *Eliomys quercinus* (range hind-foot length: 23.8–28.6 mm) the accuracy was R=3.73$\pm$0.14, IA=0.37$\pm$0.01. In *Myodes glareolus* (range hind-foot length: 15.8–23.3 mm) the accuracy was R=5.01$\pm$0.40, IA=0.50$\pm$0.03. In *Sorex antinorii* (range hind-foot length: 8.04–15.5 mm) the accuracy was R=8.11$\pm$0.96, IA=0.81$\pm$0.09. Overall the accuracy of the measurement increased from 3.73–8.04 using the rule to 0.37–0.81 with the image analysis. The higher accuracy in measuring the hind-foot length achievable with the second method, could increase the precision in estimating body condition indexes of small mammals.

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Lynx (*Lynx lynx*) monitoring in the Ossola Valley (Piedmont Region - Italy)

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The occasional presence of the lynx (*Lynx lynx*), in the Ossola Valley has been documented since the beginning of the '90s, as a consequence of the permanent Swiss population situated nearby. However, a monitoring survey conducted by Ossola Parks and Reserves (Aree protette Ossola) in collaboration with the Province of Verbano Cusio Ossola in winters 1996–1999 did not allow to gather any signs of the presence of this species, suggesting that it was not occurring regularly.

Since 2002, the sampling design and effort set up to monitor the wolf population in the framework of the Piedmont Wolf Project before, and the project LIFE WolfAlps later, has also been used to monitor the lynx. The sampling design is mainly based on a network of transects surveyed by trained operators looking for the presence of signs. Surveys take place on a monthly basis (at least) during November–April, when snow on the ground helps finding tracks and scats. At the same time the systematic collection and validation of animal observations and signs of occurrence (such as tracks, predations) reported by third parties was conducted. Within this sampling design, the use of camera traps to document the presence of the species was implemented since 2009. The data collected, critically evaluated, were then classified according to their reliability in accordance with the criteria adopted by the SCALP (Status and Conservation of Alpine Lynx Population).

Until winter 2011–2012 occurrence signs were irregularly documented and limited to a few tracks on snow found during the winters 2007–2008 and 2008–2009. From winter 2012–2013 the quantity and quality of the evidences collected showed a significant increase. In this period, we found and mapped 48 snow tracks for a total length of 61.2 km (average 20.5±6.10 km / winter), 9 predation events (3.0±1.00 per winter), 9 scats (3±1.53 per winter), and 46 camera trap pictures (15.3±5.13 per winter).

Genetic analyses performed on collected scats allowed to sample 3 different individuals, all males. A single individual was sampled in winter 2012–2013, another one in winter 2013–14, and a third one in both winters 2013–14 and 2014–15.

The coat patterns analysis of individuals sampled in the 35 pictures shot by white flash cameras allowed to identify a minimum of 2 different animals, both males (observation of testicles). Both males were certainly photographed in winters 2013–2014 and 2014–2015, one of them also in winter 2012–2013. The presence of signs of higher reliability (quality C1 and C2, according to SCALP criteria) collected in 2012–2014 cover an area of 135 km^2 (as calculated by the MPC method) situated in the northernmost part of the Ossola Valley, within the Divedro, Antigorio and Formazza Valleys.

The comparison of our pictures with the Swiss lynx image database by KORA allowed us to define the origin of one of the individuals settled in Ossola: one male was photographed in the canton of Fribourg (CH) in autumn 2011, when it was still with his mother. This site is located 94 km from where his presence has been assessed since March 2013, and document the first lynx dispersal movement from Swiss to Piedmont.

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Acorn choice by small mammals in a Mediterranean deciduous oak forest

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Several studies regarding acorn choice by granivorous rodents have been conducted in dry Mediterranean oak forests, mainly composed by evergreen oaks. However, a lack of knowledge still persists about this subject in sub-Mediterranean forests dominated by deciduous oaks. We investigated the choice between *Quercus cerris* and *Q. pubescens* acorns by terrestrial small mammals in a deciduous oak forest of Central Italy, dominated by *Q. cerris*. Using a cafeteria-style feeding experiment, we tested 14 *Apodemus flavicollis* and 10 *Myodes glareolus*. Animals were kept on-site in outdoor enclosures and given simultaneously a sample of acorns of the two oak species collected in situ. All seeds were sound and of the same size, shape and weight. Seed consumption was checked regularly, to record the percentage of consumed acorn sample. To value a possible influence of pericarp on choice, acorns were presented both whole and shelled. Biochemical composition of seeds was analysed. Acorns of both oaks resulted similar in protein, lipid, carbohydrate, ash contents and energetic value, differing only in tannins and fibre contents, with *Q. pubescens* having 51% less tannins and 35% less fibres than *Q. cerris*. The cafeteria experiments revealed a significant feeding preference by rodents for the less common *Q. pubescens* acorns, except for *M. glareolus* when presented with whole acorns. This overall preference, observed also at individual level, could reflect a general foraging strategy aimed at maximizing metabolizable energy and nutrients intake, avoiding anti-nutrients (i.e. tannins). To our knowledge, this is the first published study on acorn choice by terrestrial rodents in sub-Mediterranean deciduous oak forests. Our findings not only provide information about the feeding behaviour of these species, but also may help future researches to evaluate the role of these food resources in small mammal abundance, spatial distribution and population dynamics.

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Different flight response in two cervid species, *Capreolus capreolus* and *Cervus elaphus*, in Appennine environment

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Wild ungulates show different flight behavioural in relation to human disturbance, environmental characteristics, group size, and presence of refuges areas. It has been showed how a variation in body size can influence the flight behaviour in the species. Therefore, in species with high sexual dimorphism the females, generally smaller, are more likely to run away than the males. Protected areas often play a key role in availability of refuges and can affect the tolerance towards human disturbance and consequent flight behaviour. We investigated flight behaviour, evaluating flight distance (FD) a detectability distance (DD), in roe and red deer in a protected area in Apennine environment, where human disturbance, caused mostly by tourism, is present along with stable wolf packs, main predator of deer species. Moreover, outside of protected area a hunting plan for roe and red deer is performed in different periods of the year. FD and DD are measured by 10 sample track (2068 meters on average for each transect) repeated one times per month form April 2011 to March 2012. The distance between deer an observer was measured with a telemeter Leica LRF 1200 Scan (Solms, Germany) (range 15–110 m: precision $\pm$1 m/$\pm$0.1%) and we considered DD when deer stopped its activity because it heard the observer, and FD when deer start to move in escape direction. For each observation, we take into account the habitat where observation was made. FD and DD of roe and red deer are compared through statistical approach, and both distance are put in relation to the environmental characteristics of the observation. Our results show that red deer start to flight at a higher distance than roe deer (Mann-Whitney U test: Z=9.135, p<0.001). In addition, detectability distance are higher in red deer than in roe deer (Mann-Whitney U test: Z=8.000, p<0.001). The group composition caused a different response in both species. Flight distance was higher in roe deer female groups with fawn (Kruskall-Wallis test: χ^2=14.048, df=3, p=0.003) and in red deer female groups without fawn (Kruskall-Wallis test: χ^2=12.273, df=3, p=0.007). Detectability distance was similar in all groups of roe deer (Kruskall-Wallis test: χ^2=4.171, df=3, p=0.244), while in red deer was higher in mixed group (Kruskall-Wallis test: χ^2=14.353, df=3, p=0.002) than others compositions. Moreover, detectability distance was correlated to the group size both in roe deer (Pearson correlation coefficient: n=102, r_p=0.208, p=0.036) and in red deer (Pearson correlation coefficient: n=78, r_p=0.314, p=0.005). Consequently also flight distance was correlated to group size in both species, roe deer (Pearson correlation coefficient: n=102, r_p=0.209, p=0.035) and in red deer (Pearson correlation coefficient: n=78, r_p=0.266, p=0.019). FD and DD seem not to be influenced by habitat type in both species (Roe deer Pearson correlation coefficient detectability distance: n=102, r_p=0.031, p=0.754; Roe deer Pearson correlation coefficient flight distance: n=102, r_p=0.055, p=0.582. Red deer Pearson correlation coefficient detectability distance: n=78, r_p=0.071, p=0.536; Red deer Pearson correlation coefficient flight distance: n=78, r_p=0.056, p=0.627). Even if the habitat type did not influence detectability and flight distance, the observation had a different distribution in relationship to habitat type, and mixed deciduous wood and meadows were the main habitat type for both species. These preliminary results showed the different flight response in the two cervids species and link to the importance of body size as the smaller ones seem to be easily disturbed than the bigger, not only in individuals of the same species but also in other species. Red deer flight at a longer distance and immediately after detection of the observer, while roe deer had a lower flight distance and their slower reaction gave rise to an interval between detection of the observer and the subsequent flight response.

X Congresso Italiano di Teriologia

Ungulates in the province of Mantua

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The province of Mantua is located in the south-eastern part of the Lombardy region. Its wedge-like shape stretches between the neighbouring regions: Veneto region to the North and Emilia-Romagna region to the South. The country is mostly flat, except for some moraine hills in the northern part of the territory. It is characterised by intensive agriculture and urban development, as well as high levels of environment fragmentation and occupation. Some important rivers cross this land: the Po River along with its tributaries, Oglio, Chiese, Mincio and Secchia Rivers.

Since 2000 it has been held a data collection and georeferencing activity, concerning some species of ungulates: mostly roe deer (*Capreolus capreolus*, Linnaeus, 1758) and recently wild boar (*Sus scrofa*, Linnaeus, 1758) and red deer (*Cervus elaphus*, Linnaeus, 1758). In the past some fallow deers (*Dama dama*, Linnaeus, 1758) sightings were recorded, but it surely concerned some escaped exemplars, as they concerned ungulate farming areas and no further sightings followed.

The data mainly comes from direct observations from line transects spotted by highly qualified and trustworthy experts and from *ad hoc* surveys (spotlight night count, camera-trapping as well as indirect census method) and from the analysis of bibliography and local press.

The latest historical ungulate sightings in the plain around Mantua seem to date back to the end of the 15th century. In written texts dating back to 1825 and 1870 no reference to their presence was found. The first recent roe deer sighting in the province of Mantua can be found in 2004. From 2004 to 2008 no further sightings followed but they have significantly increased since 2011. More than sixty deer sightings were reported all over the province until January 2016. At the beginning they concerned solitary exemplars, young or adult males, as in 2010 the number of animals that live in groups led by adult females has increased. The first recorded accident dates back to the 2008 and took place near the Oglio River, on the borders with the province of Cremona. Then other accidents have followed: since 2009 five car accidents and one train accident have been recorded. It is also documented that there are several stable reproductive groups distributed throughout the province, specifically in wooded and semi-natural areas (even if included in highly urbanized contexts) and along river courses. As stated in the data, currently the local distribution is highly influenced by the sightings distribution; anyway there is clearly a strong link with the first-level elements of the Lombardy Regional Environment Network (R.E.R.) and consequently with the protected areas system and the main waterways in province of Mantua.

Concerning the wild boars, all the sightings were reported in 2015 and they mainly involve five areas: the first one is the central-west part of the province, on the borders with the province of Cremona, the second one concerns the southern part of the province, on the borders with the province of Reggio Emilia, the third one is the northern part of the province, on the borders with the province of Brescia and the province of Verona (where some striated animals have been recorded). Furthermore, close to the Mincio River, in the southern part of Mantua an exemplar crossed the road and various sightings have been recorded while, in October 2015 a car accident took place in a small village close to the Mincio River in the northern part of the city of Mantua. This information confirms the phase of colonization currently taking place in the province of Mantua.

In October 2014 two male red deers were photographed in Casatico, near the Parco Regionale Oglio Sud, in the centralwest part of the province. It was not possible to verify if they were escaped exemplars, as no further sightings of this species followed.

The emerging picture shows how even a highly anthropomorphic and fragmented territory, as the province of Mantua is, can support reproductive group of ungulates. However, this leads the territorially competent authorities and all the involved persons to take charge of the implications.

Therefore it is extremely important to undertake a systematic and structured monitoring activity, aimed to the development of suitable guidelines and more appropriate management actions in such a complex territory, as the province of Mantua is. These activities should focus on safeguarding and taking into account all the interests of the categories involved in the ungulates presence in the province of Mantua.

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Camera trapping in Bosco della Fontana natural reserve

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From June 2013 to January 2015, with some interruptions, it was conducted the monitoring activities through the usage of camera traps within the State Biogenetic Nature Reserve Bosco della Fontana (European Network Natura 2000, IT20B0011), with the aim of detecting the presence of medium and large size mammals.

Bosco della Fontana, located in the municipality of Marmirolo near Mantua, has an extension of 233 hectares and this is the remaining part of the ancient forest which, a long time ago, covered the entire Po Valley. The studying area is 85% forest and the remaining part is characterized by grassland with a small wetland. The grassland is maintained through mowing, without using herbicides or fertilizers; the grassland represents the residues of ancient prairie in the province of Mantua and is considered strictly complementary to the forest habitats. The life of Bosco della Fontana is connected to water and its seasonal fluctuations. Aquatic environments are: an important central wetland, a small natural stream (Rio Begotta), two artificial streams (Roggia Sgarzabella and Rio Parcarello), two springs (San Giuseppe and Fontana) together with several artesian wells, drainage canals and astatic waters. All of this increases the diversity of habitats. Avenues and squares that represent the orderly internal road system provide a further diversification of habitats.

Three active camera traps were simultaneously used, and their location within the reserve has changed during the activity in order to contact as many species as possible.

These instruments were placed in six different locations according to the following conditions: the camera angle was sufficiently free not to limit the potentialities of the devices, presence of environmental and morphological characteristics suitable for the transit of animals and sufficient degree of camouflage of the devices to prevent theft.

The monitoring was performed using four different models but the camera trap shooting settings were the same for all the devices used. The periods of activity have been from June 2013 to March 2014 and from January 2015 to January 2016 for a total of 620 days of activity of camera traps in six different locations.

The activity has detected the presence of nine species of mammals (and one undetermined species) that are Coypu (*Myocastor coypus*, Molina, 1782), Stone Marten (*Martes foina*, Erxleben, 1777), Striped Field Mouse (*Apodemus agrarius*, Pallas, 1771), Red Fox (*Vulpes vulpes*, Linnaeus, 1758), European Brown Hare (*Lepus europaeus*, Pallas, 1778), Common Hedgehog (*Erinaceus europaeus*, Linnaeus, 1758), Eurasian Badger (*Meles meles*, Linnaeus, 1758), Roe Deer (*Capreolus capreolus*, Linnaeus, 1758) e Eurasian Red Squirrel (*Sciurus vulgaris*, Linnaeus, 1758). These last two species had never been recorded in the Reserve before, whereas Stone Marten and Eurasian Badger were last traced in 2001. Nine bird species have also been detected and no pet has been reported.

Thanks to this survey other useful information about some of the above mentioned species have been collected; the Eurasian red squirrel was captured in four different locations, two of which are almost two kilometers away from each other and this presumes the stable presence of more individuals. The fox, the species with the highest number of surveys, is certainly present with more individuals; one fox with scabies has been identified during the whole activity. The roe deer, detected in four different locations, is present with at least two individuals in addition to an adult male. A car outside the reserve hits an adult during the camera-trapping period.

The richness and peculiarity of the species in this area (located in the heart of the Pianura Padana) with obvious characteristics of isolation, provide important information about the role of Bosco della Fontana in the Regional Ecological Network system.

The activity has updated the fauna checklist of the Reserve and the data were also used to upgrade the management plan of the Reserve/SIC/ZPS. In order to get more information about some key species aim to understanding the role of the reserve within the RER the implementation of monitoring activities "*ad hoc*" is advised.

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Survey on *Mycobacterium avium* subsp. *paratuberculosis* in a free ranging red deer (*Cervus elaphus*) population

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Mycobacterium avium subsp. *paratuberculosis* (MAP) is a pathogen causing mainly an enteric disease in wild and domestic ruminants. Previous research in red deer populations of some areas of central-eastern Italian Alps showed the maintenance of high levels of prevalence and disease as well as a widespread of the bacteria including other wild ruminants, carnivores and lagomorphs involved in its epidemiology. Furthermore, in the same areas MAP has been recognized as one of the few diseases responsible for red deer mortality.
In our study area of Tarvisio – Friuli Venezia Giulia, red deer counted 629 individuals in 2013. During the hunting season 2013–2014 a total of 18 intestines were collected for the search of MAP and MAP associated lesions. Age of sampled deer was distributed as follows: 33% yearlings, 27% sub-adults and 40% adults. Gut lesions were classified according to gross pathology, severity an distribution (Classes 0, A, B, C1, C2, C3): absence of lesions in Class 0, limited lesions to lymphatic system in Class A, catarrhal or catarrhal-hemorrhagic enteritis in Class B and progressive increasing of severity and distribution of lesions consistent with paratuberculosis in C1, C2 and C3, including thickening of the wall, wrinkling of the mucosa and enlargement of lymph-nodes. We used an IS-900 PCR for the detection of the pathogen from the ileocecal valve and associated lymph-nodes. All deer presented some degree of enteric or lymphatic lesions; therefore no individual was attributed to the class 0. The distribution of the samples resulted as follows: class A 11% (2/18); class B 77% (14/18), class C1 11% (2/18), class C2 0% (0/18) and class C3 0% (0/18). Hence, only limited lesions in two subjects could have been reported as indicative of a MAP infection, although not pathognomonic and deer with class C1 lesions were yearlings. These results were in accordance with the analysis for MAP in gut and lymph-nodes, that was negative in all samples (0/18; maximum possible prevalence 15.26% at 95% C.L.).
These findings differ from results in red deer populations from western and central-eastern Italian Alps, where the prevalence of infection ranged from 20% to 80%. The absence or low frequency of lesions suggestive of paratuberculosis and the negative PCR results suggest a limited spread of MAP in the studied red deer population. Since the prevalence of infection in red deer populations is density dependent, these results will need to be reconsidered in case of further increase in populations densities.

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Thermoregulation and energy intake: a crucial trade-off for thermally sensitive species

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As the climate warms, many species are likely to experience increases in ambient temperature because their range-shifts are lagging behind climate change. For thermally sensitive species, even small increases in air temperature can have negative effects on their life history traits. Under climate change such species may experience increasingly precarious trade-offs between investment in thermoregulation and in other life history strategies. Quantifying these trade-offs in current climatic conditions is an important first step to understanding how those species may be affected by climate change.
Endotherms, such as mammals, may be reliant on responding to changes of the climate using behavioural thermoregulation, which is thought to be less energetically expensive than autonomic thermoregulation. Thermoregulation can be an important driver of habitat selection but it may push animals away from areas that are most favourable in terms of food resource productivity.
We investigated the potential for a trade-off to exist between thermoregulation and resource acquisition by examining the seasonal modifications of resource selection of male Alpine ibex (*Capra ibex*) in the Gran Paradiso National Park. We also analysed animals' time budget and their faecal content in order to understand if ibex were able to adjust their food intake depending on the quality of the food patch where they foraged.
We showed that thermoregulation is an important driver of ibex behaviour that could compromise their resource acquisition. The ambient temperature constrained the access to resources: when temperature was low ibex selected the best food patches, but when temperature increased they were forced to select lower quality foraging areas. In these areas, ibex seemed not able to compensate for reductions in forage quality/quantity by adjusting the time they spent feeding during daylight hours. Additionally, feeding time during the day was constrained by high air temperature. Some suggestions exist about ibex ability to adapt to higher temperatures by spending more time foraging at night. Preliminary results about the data of GPS-collars showed that ibex were always less active during the night than during the daylight hours.
Our findings revealed a crucial role of the trade-off between thermoregulation and energy intake in thermally sensitive species, which could impact negatively their survival and reproduction in the future.

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The project LIFE+ "One deer two islands": preliminary results of the reintroductions of *Cervus elaphus corsicanus*

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The Sardinian-Corsican deer (*Cervus elaphus corsicanus*) is a deer subspecies, endemic of Sardinia and Corsica, inserted by the European Community in the list of 50 species of Italian mammals with a priority conservation interest. In the period between the 50s and 60s this subspecies was on the verge of extinction: it was estimated about 100 animals in Sardinia (in three disjointed distribution areas) while the species appeared extinct in Corsica. This decline was due to the fragmentation of the population, which was caused by the drastic reduction of habitat (consequent to deforestation and fires), hunting and poaching. In Sardinia, the deer population had a significant increase due to one of the most important conservation campaign carried out in Italy by the Forestry Agency of Sardinia (EFS) and the Italian WWF. In 2015, it was estimated over 8000 specimens of *C. elaphus corsicanus* in Sardinia. In Corsica, 3 translocations of deer from Sardinia have been performed since 1985. Moreover, 13 releases of deer from fences, have been carried out by the staff of the Regional Natural Park of Corsica (Parcu Corsica), since 1998. A total of 260 deer have been released in 5 different areas ("Caccia-Ghjunsani", "Venacais", "Fium'Orbu", "Alta Rocca", "Dui sorru-Dui sevi").

Nevertheless, the conservation of *C. elaphus corsicanus* was still particularly critical because of several problems such as the inbreeding, the distribution in disjointed areas and the conflicts with some human economic activities in the areas with the highest density of these animals. For this reason, in September 2012, the EFS together with the provinces of Medio Campidano and Ogliastra, the Institute for Environmental Protection and Research (ISPRA) and the Regional Natural Park of Corsica (Parcu Corsica) started the project "One deer two islands" funded by the LIFE+ Nature. The aim of this project is to increase the status of the species conservation, creating new source populations in Natura 2000 sites, to reduce the causes of conservation risks, to promote the cooperation between people involved in the management of deer, to elaborate a comprehensive management plan, to share good practices among partners and especially to mitigate existing and/or future conflicts between deer populations and human activities. The project will end in 2018.

The present study represents a preliminary analysis of the data collected during the project. In particular the survey analyzes the telemetry data related to some animals released in Natura 2000.

To date, 54 deer have been released in Sardinia in the 2 distinct SCI "Monti del Gennargentu" and "Golfo di Orosei": 33 wild deer were captured in the province of Medio Campidano and the other 21 deer came from a restocking wildlife fence of EFS. Among the released animals, 19 were equipped with a GPS radio-collar and were monitored in all subsequent stages of the release. The specimens showed a good adaptation to the new environment that have been monitored for more than one year have shown a Home Range between 97 and 647 hectares (MPC 95%). In general, the animals from nature have revealed a greater propensity to dispersion than the animals released from the EFS fence. In the SCI "Golfo di Orosei" they have used the area near the release site, while in the area located in the SCI "Monti del Gennargentu" the deer have shown a greater propensity to dispersion. The mortality rate among the realased animals with radio collar, after one year, was 26.3%, and the presumable causes of death do not seem to be related to human activities. Moreover, the public opinion in the relase site has not shown a negative reaction, thanks to the considerable works of mitigation performed as a part of the project. This evidence seems to be, rather favorable to the establishment of new populations of deer in Sardinia.

At the same time, 15 deer have been released in Corsica in the SCI "Tartagine" as part of the same project .Ten animals came from the Quenza fence of Parcu Corsica in March 2014, whereas 5 animals were translocated from Sardinia in December 2015. Among the released deer, 3 were equipped with GPS radio-collar and 3 were equipped with VHF radio-collar. The deer showed a good adaptation to the new environment and those that have been monitored for more than one year showed home ranges between 228 and 412 hectares (MPC 95%).

Overall, the animals released in Corsica and Sardinia seems to display a differential use of the occupied territory during the year. This behaviour is probably related both to trophic availability (food and especially water), which undergoes to considerable seasonal variation, and to some human activities (hunting and farming) that can create noise at certain periods of the year, especially in Sardinia.

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Evidence of domestic allele introgression at MC1R and NR6A1 loci across European wild boar populations

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Domestication processes promote the emergence of novel phenotypic and behavioural traits in domesticated animals compared to their wild ancestors, due to relaxation of purifying selection in the captive environment and the strong human selection for diversity, tameness and specific desirable traits. Therefore, domestic populations may show private gene variants at loci influencing phenotypic traits, and these alleles, if detected in their wild conspecifics, can be used to study recent or past hybridization events. Domestic alleles introgressed into wild populations, however, can have unpredictable effects on fitness that may lead to decreased viability or increased invasiveness of populations. The MC1R and NR6A1 genes influence coat colour and number of vertebrae in Sus scrofa, respectively. We analysed their variation in 145 wild boars sampled throughout Europe, in order to investigate the presence, frequency and spatial distribution of domestic alleles in European wild boar populations. Most of the wild boars (94%) were homozygous for the European wild-type (E+) MC1R allele. The remaining wild boars (6%) showed genetic introgression of three different European domestic alleles. No Asian MC1R allele was found in our sample. Domestic NR6A1 alleles were observed in 6% of wild boars. Considering the two loci jointly, 11% of boars, sampled all over Europe, showed signs of recent or past introgression in their genome. These data, in agreement with previous studies, confirm the occurrence of widespread introgression of domestic alleles in the European wild boar. MC1R and NR6A1are useful markers to study hybridization between wild and domestic forms, and, compared to neutral genetic markers (e.g., microsatellites), can possibly identify the selective impact of these processes.

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Alien species: raccoon (*Procyon lotor*) in Foreste Casentinesi National Park

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Raccoon (*Procyon lotor*) is a medium-size mammal native of North America. Italian regulations consider it an exotic animal added in the list of "dangerous animals that required specific authorization for possession" (All. A - D.M. 19 April 1996). Actually European Union put this animal in the list of Alien Invasive Species (Reg. 1143/2014). The Regulation foresees three types of interventions: prevention, early detection and rapid eradication, and management.
Actually absence of legislation and fragmentation of roles and responsibilities in Italy doesn't permit to manage correctly "alien species". Procedures adopted by National Park are described in detail. The presence of raccoon in Foreste Casentinesi National Park is recorded from 2013. CTA CFS (Corpo Forestale dello Stato, CTA = Park Ranger) collects all records: reports, animals found dead, photo trapping videos. Main records are focused in an area of 13 km^2. Spot of expansion are recorded in a distance of 7 km. Main steps adopted by National Park to manage this problem are:

- Inquiries about the origin of the spread;
- Opinion request to ISPRA (Istituto Superiore per la Protezione e la Ricerca Ambientale);
- Approval of eradication plan by the National Park board of direction;
- Approval of eradication plan by ISPRA (Istituto Superiore per la Protezione e la Ricerca Ambientale);
- Plan implementation.

Eradication plan steps are:

- Photo trapping monitoring. Starting from the core area photo traps are dislocated to detect the presence of raccoons. Main records occurs near creeks;
- Capture with live traps and baits. Cat traps and dry cat food are tested. Traps are adapted to avoid escapes;
- Translocation of caught raccoons in authorized detention centres where they are neutered and identified with microchip;
- Health surveys.

Adequate information towards local population has been established. First results are described.

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Tick presence on newborn roe deer in two different swedish environments

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Ixodes ricinus is the main vector of several tick-borne diseases and can transmit pathogens to humans. Human cases of tick-borne diseases have increased during the last 10 years all over Europe and this could be due to density increasing of this tick. The hosts availability and composition affect the density of ticks since *I. ricinus* have a life cycle on different hosts. During the immature stage it typically feed on small to medium-sized mammals and birds and during the adult stages they prefer large mammals, in particular ungulates. Understand the role of different hosts to contribute to surviving and abundance of ticks is therefore important to information useful in the management of diseases prevalence.

Samples of ticks were collected on wild neonate roe deer fawns (*Capreoulus capreoulus*) captured by hand during May–June in two different areas of south-central Sweden. The first site is located around Grimsö Wildlife Research Station (59° 40' N, 15° 25' E) in the boreal zone and it is characterized by long and cold winter. The second area is located at Bogesund (59° 24' N, 18° 12' E) in the hemiboreal zone north of central Stockholm where the winters are short and mild and an higher roe deer density is present. Collected ticks were killed by freezing (<20 °C), transferred to the laboratory for identification, sorted in relation to species, sex and development stage and later checked for the presence of the different etiological agents.

Three reproductive seasons of sampling have been performed up to this date. A total of 1031 ticks were collected from 74 fawns in Grimsö and 1605 ticks from 83 fawns in Bogesund during 2013–2014–2015. We observed that the number of ticks feeding on fawns was larger in Bogesund than in Grimsö. The milder climate helps the reproduction of ticks and reduces the winter mortality. Higher winter temperatures might have led to increase tick abundance, which we observed during the spring–summer of 2015 when more ticks were found in both areas. In fact, the total ticks per unit increased in Grimsö area, from 3.82 (2013) and 6.40 (2014) ticks per fawn to 29.15 ticks per fawn in the 2015, while in Bogesund the average tick burden didn't increase so much. In both areas were found more nymphs than the other stages; during the last year of sampling in Grimsö 0.25% of the sampled ticks were larvae, 54.51% nymphs and 45.24% adults. In the second area 11.04% were larvae, 60.34% nymphs and 28.62% adults. Significantly more ticks were found on roe deer fawn from areas with higher roe deer and rodent density, indicating a positive correlation with host abundance.

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Wolves and wild ungulates: spatial and temporal interactions and selection of prey

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Wolves (*Canis lupus*) are generally considered generalist and opportunistic predators, which typically select the most vulnerable and abundant prey species living in their territories. We investigated spatial and temporal interactions between wolves and wild ungulates and we analysed wolf diet to point out the elective prey of wolves and to address the relationship between predator selection patterns, prey availability and prey vulnerability. The research was carried out in a study area located in the south part of Western Alps (Ligurian Alps), characterized by a rich wild ungulate community consisting of three stable species: wild boar (*Sus scrofa*), roe deer (*Capreolus capreolus*) and chamois (*Rupicapra rupicapra*). From October 2012 to September 2015 we recorded the occurrence of target species from their signs of presence detected along 14 randomly selected transects following a Tessellation Stratified Sampling design and by camera trap surveys. To increase the detection probability, we spaced camera traps taking into account the results of previous studies on wolf presence in the study area. We considered two distinct ecologically based seasons: reproductive (from 1 April to 30 September) and dispersion season (from 1 October to 31 March). Furthermore, we calculated the availability proportions of wild ungulates from the presence signs recorded on itineraries. Wolf scats were collected and addressed to laboratory analyses to identify the consumed food categories and the prey species. Finally, we evaluated wolf selection of wild ungulate species. Collected data were used to estimate species distributions with the fixed Kernel estimator. Therefore, we quantified spatial overlap between the wolf and each wild ungulate species through the utilization distributions overlap index (UDOI). We also studied the activity patterns of wolves and wild ungulates to estimate the probability of both species concurring in a time period. We estimated species activity patterns through the probability density function using the Kernel density estimator. We also quantified temporal overlap between the wolf and each wild ungulate species patterns using the coefficient of overlap (Δ_1). Our analyses showed a general very high spatial overlap between wolves and wild ungulate species (UDOI=0.62), but only between the wolf and the wild boar we observed a high temporal overlap (Δ=0.67). Indeed, roe deer and chamois displayed significantly different activity patterns from those of the wolves (Δ=0.55 and Δ=0.33 respectively). Scat analyses revealed that the diet of wolves was characterized by a high consumption of wild ungulates (79.4%) and by a low occurrence of livestock (15%). Wild boar was the most consumed prey species (43.3%; reproductive season=42.6%; dispersion season=44.3%) and roe deer was the second most consumed wild ungulate by wolves (35%; reproductive season=36.6%; dispersion season=32.9%). Finally the frequency of occurrence of chamois was lower (2.8%; reproductive season=1%; dispersion season=5.1%). Selection of wild ungulates was partially influenced by their availability; however other factors as prey anti-predator strategy and body size could have an important role in species selection by wolves. The roe deer was selected in all considered seasons, whereas the chamois and the wild boar were used as available during the dispersion season and avoided during the reproductive season. Our results suggest that the wild boar may play a more important role than other wild ungulates in influencing wolf activity and behaviour, as underlined by the high spatial and temporal overlap, especially during the dispersion season; during the reproductive season the wolf may probably take advantage of roe deer fawn presence, as suggested by its diet.

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Alien ungulate species in Mediterranean habitat: activity pattern and management

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Ungulate alien species are present in all Europe. One of the factors behind the prevailing trend towards the loss of biological and landscape diversity is the introduction of alien species into ecological systems.

As well as for Italy not only there were in the past movement of species. In Croatia were introduced several species of plant and animal for different purpose. Hunting games were one of the most important purpose for the introduction of animal species, especially for ungulate species, i.e. Fallow deer (*Dama dama*), Axis deer (*Axis axis*), Mouflon (*Ovis musimon*) and Barbary sheep (*Ammotragus lervia*), which have been deliberately introduced to hunting grounds.

The mouflon was introduced in north-west part of Croatia in 1900. This population was exterminated after World War I. A second introduction was made in 1908 on the island of Veliki Brijun near Istria. In the years following, mouflons were introduced in Croatia in several islands, on four coastal hunting grounds and on hunting grounds in Slavonia (Panonian mainland). However, in Italy the mouflon was introduced to Sardinia in 6000 BC, where the species is commonly considered as "native through long establishment". Several introductions were performed during the last century in the Alps, Northern Apennine, and coastal Tuscany, all using mouflon of Sardinian origin. At the end of last century Sardinia distribution significantly decreased, in meanwhile the other Italian populations increase.

As for translocations from Sardinia to mainland Italy, also in Croatia all populations of mouflon spread and become stable, causing also damage. There they have negative impacts on the biodiversity and on domesticated animals and indigenous wildlife. They are often carriers of new pests and diseases. In addition, introduction of different subspecies as Roe deer, Red deer, Axis deer, Fallow deer and other populations caused the same problems.

The research have the target to assess the activity pattern between different non-native ungulate species in the Adriatic island of Rab and to relate the influence of external factor, i.e. environmental and human impacts, on the activity pattern.

The study area of total 800 ha was located in the western part of Rab, which belongs in euro-Mediterranean vegetation zone. The main forest ecosystems are holm oak forests with black ash and artificially established stands of Aleppo pine, Maritime pine, and Turkish pine. The average annual air temperature is 15.3 °C, and the amount of rainfall is 1100 mm.

To study the different species behaviour eight IR camera traps were positioned close to feeding grounds from April to September 2015. In the period, 67356 images were collected of Mouflon, Axis deer, *Martes* spp., European hare (*Lepus euopaeus*) and *Rattus* spp.

Concerning the daily activity for the ungulates, it can be described as a bimodal which is typical pattern described in most other ungulates. European mouflon are mostly active during dawn and dusk, while Axis deer are mostly active during the evening, throughout the night until early morning. Between mouflon and axis deer there was no behavioural or interspecific avoidance. Further studies are needed to clarify whether this activity pattern is typical or it reflects a temporal niche shift, because impact such as temperature and/or tourism may also effect on animal activity.

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Preying hares is the sole method used by carnivores for causing their death?

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Carnivores come into contact with many infectious agents due to their position at the top of the food chain. Thus, they could be potential carriers of some infectious agents that occur in their prey species even if they are not susceptible, and are not infected nor develop clinical signs. This is the case of lagoviruses, which are specific agents of severe disease in rabbit and hares respectively Rabbit Hemorrhagic Disease (RHD) and European brown hare syndrome (EBHS). EBHS is a highly contagious disease of brown hares (*Lepus europaeus*) and, with lower frequency, of other hare species (*Lepus timidus* and *Lepus corsicanus*). When introduced into a naive brown hare population, EBHSV infection achieves almost 100% morbidity. Mortality is about 50% in the adult age class but absent in young individuals less than about 2–3 months of age. These young individuals when come in contact with the virus, become infected, do not exhibit any clinical signs but seroconvert developing a long-lasting immunity with low-medium antibody titers. The virus is considered endemic in all European countries including Italy, forcing the adoption of surveillance programs in order to control the diffusion of the disease and the dynamics of hare populations. During the annual serological surveillance of hares captured for restocking in a protected but open (i.e. not fenced) area, managed as "breeding-for-restocking" ground, one dead hare was found, collected and conferred to IZSLER for laboratory examination. Few days after, four red foxes were hunted in close proximity of the same area and then delivered to IZSLER for laboratory investigations, according to the Regional program for wildlife monitoring. At necropsy the typical lesions suggestive of EBHS were found in the hare carcass i.e. petechial lung haemorrhages, friable, fatty and discolored liver with an accentuated lobular pattern. The diagnosis was then confirmed by detecting positive results for EBHSV in the liver and spleen homogenates by both sandwich ELISA and RT-PCR. All the hare sera sampled during the capture operation tested positive in serological c-ELISA with high titers. This result is ,indicative of an active circulation of EBHSV in that area. Thereafter, in order to elucidate the epidemiological role of predators and to confirm previous experimental data indicating the possibility that carnivores, after having predated diseased or dead lagomorphs, can excrete infectious lagoviruses with feces, we examined by RT-PCR for the presence of EBHSV the liver, spleen, mesenteric lymph nodes and intestinal contents (collected from the duodenum, cecum and rectum tract) of the four red foxes. The intestinal content of one fox resulted virologically positive, whereas the other organs and all the viscera of the remaining three foxes resulted negative. Among the food debris present in the gastrointestinal contents of the positive fox we found the presence of materials genetically identified as of hare origin. The 4 foxes were also serologically tested for EBHSV antibodies by c-ELISA with negative results. The identified EBHSV strains from both species were amplified, sequenced and compared. Partial sequence of VP60 gene amplified from the positive fox, showed a nucleotide identity of 96% compared to the Italian reference strain EBHSV_BS89 (X98002). These results proved, for the first time in natural condition, the possible epidemiological role of carnivores as passive vectors of EBHSV. In particular, red fox feeding on infected hares might contribute to spread infectious viral particles, thus promoting the persistence and occurrence of EBHS cases. However, further studies are needed to verify the impact of this specific epidemiological role of the red fox in the complex epidemiology of EBHSV.

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Habitat selection of European badger in a highly fragmented forest landscape: the importance of agroforestry

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The European badger is a common and widespread species, considered as least concern by IUCN. However, there are still many threats for the species conservation. The main cause of species mortality is the road killing, followed by habitat loss due to land use changes, disease, and culling related to bovine tuberculosis eradication. The aim of this study was to define the habitat selection of this species in a highly fragmented agro-ecosystem in northern Italy and to understand the role of agroforestry for the species. The data collection followed a stratified random sampling design and consisted on spotting signs of presence along linear transects, walked from April to September 2014. We defined the habitat selection by resource selection probability functions using GLMs. We found that in our study area the European badger selected broadleaved forests, hedgerows, traditional poplar plantations, short rotation forestries and reforestations, while it avoided transitional woodland/shrubs areas and areas with scarce or absent vegetation. In conclusion, in a typical agro-ecosystem in northern Italy the agroforestry seems to have a great importance for the European badger, both in providing food resources and suitable setts location.

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Relevance of behavioural states for identifying potential dispersal corridors

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Traditional methods to identify and design conservation corridors range from expert based approaches, to individual based models, spatially explicit population models, and models based on estimates of ecological or Euclidean distances. A surface of resistance to movement is often used to highlight areas where movement is less or more likely to occur. Widely used modelling methods, such as least-cost path analysis or circuit theory, use resistance raster coupled with different algorithms to analyze landscape connectivity and to predict corridors. Resistance surfaces are built according to resource selection patterns, which are generally rendered by modelling use vs. availability based on the animal's locations. However, as drivers of selection may vary depending on specific behaviors (e.g., foraging, denning, travelling within the home range or dispersing), context-dependent modeling should acknowledge that an animal's interaction with its environment depends on its behavioral state. On the contrary, many applications of cost-based corridor models have the intrinsic weakness of using all data points, neglecting the behavioral state of the animal at the time the points were collected.

To explore the extent to which a context-dependent approach may affect our final perception of structural corridors, in this study we compared a traditional modelling approach (in which the resistance surface is based on a "generic" habitat suitability) with a "behavioral" approach: in the latter, we accounted for both the behavioral state (movement vs. other) and gender to estimate the resistance surface. Using the Apennine brown bear (*Ursus arctos marsicanus*) in the central Apennines (26.024 km^2) as a study case, we used 3 different datasets of adult bear GPS-locations to create 3 surface resistance rasters: 1) all available GPS locations, irrespective of the bear's behavioral state; 2) GPS locations of male bears moving in the landscape, 3) GPS locations of female bears moving in the landscape. We distinguished GPS locations that refer to a "moving" state by (*i*) using only GPS locations acquired at high rates (i.e., 1 location/ hr.; 31.209 locations collected on 18 adult bears from 2005 to 2010), and (*ii*) subselecting trajectories featuring $\geqslant 3$ consecutive locations at least 800 m apart from each other. Using an ensemble modelling approach (package `biomod2` in R) we created 3 models representing the probability of movement throughout the study area: a traditional resistance surface (dataset 1), a male-based movement-dependent resistance surface (dataset 2), and a female-based movement-dependent resistance surface (dataset 3). Considering 15 critical areas of conservation across the central Apennines as starting points, we then used each of the 3 resistance surfaces as a background to implement 3 most commonly used corridor algorithms to identify structural corridors: least-cost path (ArcGIS, v. 10.2.1), least-cost path (Linkage-Mapper, v. 1.0.9), and circuit theory (CircuitScape, v. 4.0.5).

For each resistance map we obtained different corridors whatever algorithm we considered. Using least-cost path analyses implemented over behavioural-dependent resistance surfaces we identified corridors at 2.5–5.3 km apart from those identified over traditional (i.e., no behavioural) resistance surfaces. The same was true using CircuitScape, where overlap among identified corridors based on different resistance surfaces was rather low (20%–40%) for higher connectivity areas.

Our results indicate that the three resistance rasters lead to very different corridors designs, irrespective of the corridor algorithm, emphasizing that gender and behavioral state do affect our perception of resistance surfaces. Therefore, in order to model structural connectivity using resistance surfaces, we stress that the latter should be estimated using context-dependent approaches, possibly accounting for behavioral state and relevant group variables (e.g., gender).

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Monitoring wildlife health status in Sirente Velino Regional Park: preliminary considerations

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Wildlife Health surveillance is increasing as a fundamental activity not only for disease management in species conservation programs, but also in a public perspective of livestock and human health interactions.

Environmental changes, continuing pastures depopulation and natural habitats changes favor numeric increase of many wild species. Therefore they also determine the increase in interactions between domestic livestoch and human activities, both on a spatial and on a health basis.

Sirente Velino Regional Park, instituted in 1989 (L.R. 54/1989), currently extends to approximately 540 km^2 and includes five Natura 2000 sites.

In the Protected Area there are numerous species listed in 92/43 EEC Directive and 2009/147 EEC Directive, including *Ursus arctos marsicanus*, *Canis lupus*, *Gyps fulvus*, *Aquila chrysaetos*. In the same area, that comprehends 22 mubnicipalities, are also present about 6000 sheep and goats, 1200 cattle and 500 horses, all in mountain pastures.

The present study, still in progress, started in 2011 as a sideline to the Apennine Chamois reintroduction LIFE project (LIFE09 NAT/IT/000183 COORNATA, Development of coordinated protection measures for Appennine Chamois), continued in 2015 in a more intense way, and allowed so far, the evaluation of wildlife carcasses and feces.

Each sample was georeferenced and according to necropsy findings, processed for bacteriological virological and parasitological analysis, in order to assess the cause of death and understand the health status, especially for those diseases that can possibly pose a threat to wildlife conservation as well as constituting a risk for livestock and Public Health.

We recovered 104 samples, 23 carcasses and 81 fecal samples. In 19 wild mammal carcasses (carnivores, artiodactyls, and mustelids) it has been possible to assess mixed parasitic infestations (*Cromosoma vulpis* eggs; Strongylids; Coccidia (6000 opg), *Nematodirus* and *Trichuris ovis*, *M. capillaris*, *Capillaria* sp; *Trichuris vulpis*; *Metastrongylus apri*; *Trichuris suis*; *Ascaris suum*; *M. capillaris*; Ancylostomatidae).

The Canine Distemper Virus (CDV) has not been isolated from any carcass, while in one fox and in one wolf carcass the Canine parvovirus (CPV) was isolated. *Trichinella britovi* was instead identified in a carcass of a young wolf, the same specimen found positive one for Canine parvovirus.

Collection and subsequent analysis of ticks (*Dermatocentor marginatus*: 7 of which 2 males and females), taken from 2 wild boar carcasses has enabled respectively the isolation of *Rickettsia slovaca* and *Rickettsia* spp., and on two fox carcasses one female *Ixodes ricinus* and *Rickettsia elvetica* and *Rickettsia* spp.

The current study started considering urgent and concrete need to have a framework to assess, at least generally, wildlife health status in the Park, and it is also necessary in order to further prepare those actions and wildlife management and conservation measures, also to reduce livestock-wildlife and human activities conflicts.

It is also so important to obtain a better and effective collaboration between Park Authority and the local Community for a species management and biodiversity conservation program.

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Wild boar (*Sus scrofa*) management through mobile traps in Sirente Velino Regional Park: health monitoring according to "One Health" approach

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Steady free-living wild ungulates number increase, especially of Eurasian Wild Boar (*Sus scrofa*) in the Protected Areas, as well as in much of the Italian national territory, is one of the most important causes of serious and increasing conflict between Parks authorities and agricultural same territory activities.

According to the specific regulation and management plan of the wild boar population in the Park and after obtaining the requisite opinions and authorizations in Sirente Velino Regional Natural Park from the month of May 2015 are in progress reducing population wild boar density strategy activities through mobile traps, further transport, health monitoring, slaughter and sale of, in this way, obtained meat in Protected Areas.

The aim of this study, therefore, is describing the technique used, the procedures put in place and the results so far obtained from the wild boar health monitoring and in particular the concrete possibility to activate and promote a real bush meat chain obtained from wild animals reducing population density and management program.

Captured wild boars, are selected and judged clinically, if healthy and fit they are transported to slaughterhouse in accordance with established protocols jointly with the Public ASSLL Veterinary Services.

In the capture site work togheter: Scientific and Monitoring and scientific Sirente Velino officer (veterinarian, biologist and wildlife technicians) Forestry Guard, Ecozoofile National Guard (GEN).

Captured wild boars are identified by application of the official IZS ear tags (unique code in order to ensure traceability).The captured animals transported live in wood cages.

At the slaughterhouse wild boars are tested (serum and organs) against several diseases. Wild boar health monitoring has important implications for the conservation of brown bear (a brown bear died in 2012 in the Sirente Velino Natural Park for probable Aujeszky).

These monitoring activities are also aimed at evaluating livestock and Public Health risk in accordance with the "One health" principles to improve collaboration between human and veterinary medical and environmental science.

Overall, 54 animals were captured, monitored and slaughtered in 14 days, through the activation of two mobile traps.

Serological investigations carried out on those 54 animals have shown the following positives: for *Brucella suis* (N=9) Aujeszky, (N=8) and *Francisella tularensis* (N=1).

54 liver samples were analyzed, and it was possible to isolate the HEV virus from 4 samples. In total 54 fecal samples were analysed and 43 samples tested positive for intestinal parassites. In particular, the following parasite species were identified: the Strongili eggs, coccidia oocysts, *Metastrongylus apri*, *Ascaris suum* and *Trichuris suis*.

The collection and subsequent analysis of ticks in the months of October and May 2015 (*Dermatocentor marginatus*) taken by 2 carcasses of wild boars has allowed the isolation of *Rickettsia slovaca*.

This strategy, directly and actively involve farmers themselves who suffer the damage from wild mammals living free in the management and maintenance of fences grow in their culture and sensitivity towards the conservation and management of wildlife (expecially wild boars).

Using this strategy it is thus possible reduce conflict between wildlife and human activities; integrate and closely connect wildlife health, human health and mammal conservation programs.

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Infanticide in brown bear (*Ursus arctos*): understanding a case in Trentino

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Infanticide (Sexually Selected Infanticide - SSI) is a documented behavior in several mammalian species and may represent a male reproductive strategy because females who lose cubs may quickly enter again in estrus. In non-social mammals (such as brown bear — *Ursus arctos*), the SSI phenomenon has rarely been documented.

In May 2015, sampling and subsequent genetic analysis, according to the agreement between PAT and ISPRA to monitoring large carnivores in the Central Alps, allowed to detect the first infanticide case documented through genetic analysis in Italy on the brown bear. The infanticide degenerated into death of the cubs and even of the mother, perhaps in an attempt to save them. The recovery of the female and two cubs bodies allowed collecting two types of biological samples: tissues from the corpses, and saliva, through swab on mother's injury, hoping to isolate the DNA of the infanticide male. The samples were sent to the ISPRA genetic laboratory in Ozzano Emilia, and analyzed by PCR-amplification of 15 autosomal microsatellite loci, following the protocol described into the PACOBACE (Interregional Action Plan for the Brown Bear Conservation in the Central-Eastern Alps), and routinely used for individual bear identifications in the study-area.

The open-source LRmix Studio software (version 2.0.0-Community Edition), dedicated to the interpretation of forensic human genetic profiles, can identify the individual DNA sources from complex DNA mixtures of two or more individuals. With the availability of the complete genetic database of the bear population that was genotyped since 2000 and the associated field data, it was possible to identify all the males in reproductive age (potential infanticide) and to calculate the allele frequencies of the population. The use of LRmix Studio on our data, therefore, enabled to isolate alleles that do not belong to the victims and finally to identify the infanticide male.

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Studio parassitologico su volpi come strumento di indagine del territorio

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L'aspetto delle interazioni tra fauna selvatica e specie domestiche merita una particolare attenzione in considerazione del fatto che gli eventi di natura parassitologica vanno studiati per i loro risvolti sanitari ed ecologici.
Il ruolo della volpe come serbatoio di parassiti agenti di zoonosi comuni ai canidi con il quale l'uomo ha maggior possibilità di contatto è ben conosciuto. Con questa finalità, gli studi condotti per accertare la natura della fauna parassitaria di mammiferi selvatici come la volpe rivestono anche carattere culturale e conoscitivo allo scopo di acquisire maggiori informazioni circa le popolazioni ai fini della conservazione. In questo contesto un programma di controllo sanitario si può affiancare a studi di corretta gestione e uso sostenibile del territorio.
Presso i laboratori dell'Istituto Zooprofilattico Sperimentale della Sicilia sono pervenute nel corso degli anni 2014 e 2015 30 carcasse appartenenti a volpi oggetto di attività venatoria o di ritrovamento nel territorio della provincia di Palermo. In sede di esame autoptico sono stati prelevati campioni di feci e l'intestino dei soggetti pervenuti esaminati con le tecniche classiche di copromicroscopia per la ricerca rispettivamente di uova ed oocisti di parassiti e di forme adulte di vermi intestinali. Le indagini sui campioni di feci hanno registrato la presenza di uova di nematodi nella quasi totalità dei soggetti di cui uova di Ancylostomatidae (nel 56.6% dei campioni), Trichuridae (30%), *Toxocara* sp. (6.6%), oocisti di coccidi (10%), *Giardia* 3.3% e uova di cestodi riferibili a *Taenia* sp. nel 3.3% dei casi. Le forme adulte ritrovate sono state attribuite a *Toxocara* sp.
Tale indagine si inserisce in uno studio più ampio rivolto alla correlazione tra la presenza di agenti parassitari nella fauna selvatica del territorio siciliano correlata alle abitudini alimentari, alla disponibilità trofica, all'habitat in genere e potrà esitare nella registrazione delle relative tendenze e frequenze stagionali.

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Ambiente disturbato? Sorprese dal monitoraggio fotografico nel territorio della cava di Monte Tondo

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Uno degli assunti che vengono dati per scontati nell'analisi territoriale è l'effetto di disturbo pesante arrecato alla componente macrofaunistica dalle attività di escavazione. Nell'ambito di una ricerca volta a verificare le sorgenti di impatto verso la fauna di diverse attività dell'uomo, grazie all'attenzione della Saint-Gobain GYPROC Italia, si sono volute valutare le presenze della grande fauna nel territorio dell'ultima grande cava attiva di gesso presente in Emilia Romagna, la Cava di Monte Tondo nel Comune di Riolo Terme. Con il posizionamento in ambiti specifici a diverso ipotetico disturbo e quindi a distanze progressivamente maggiori dall'area di scavo e di passaggio dei mezzi, sono state utilizzate trappole fotografiche Scout Guard posizionate in 3 punti caratteristici: in vicinanza del fiume, in un boschetto con evidenti passaggi di fauna posto a circa 50 m dal passaggio dei mezzi e presso un punto con acqua per le abbeverate a circa 100 m dall'area di scavo. Le trappole sono state controllate con una cadenza mensile da aprile a giugno 2015. Su un totale di 255 giorni/trappola sono stati raccolti 895 scatti che hanno "catturato" 444 immagini di animali, rivelando la presenza di 13 *taxa*. Tra i carnivori *Canis lupus*, *Vulpes vulpes*, *Meles meles*, *Martes foina*; tra gli ungulati *Sus scrofa*, *Capreolus capreolus* e altre specie quali *Lepus europaeus* così come *Strix aluco*.
Si è riscontrata una fauna di meso e macro mammiferi davvero considerevole nell'area indagata, molto superiore alle aspettative. Uno degli assunti troppo spesso ribaditi è che, nelle zone ad attività industriali, l'elevato disturbo ponga un limite alla frequentazione delle aree soprattutto per quanto attiene appunto alle specie considerate particolarmente sensibili, quali ad esempio i predatori.
Nonostante la presenza umana risulti fonte di alto disturbo e le operazioni di lavorazione siano decisamente rumorose e impattanti, un sito come questo comunque fornisce alle specie presenti una sorta di "area rifugio", in cui non vi è permesso di accesso né di caccia, essendo vietato al pubblico. Inoltre le zone disturbate per i lavori di scavo sono nel contempo circoscritte nello spazio e nel tempo e largamente prevedibili da parte degli animali. In questo contesto numerosi sono stati gli avvistamenti di specie quali faina, tasso e istrice che, essendo notturni, sono normalmente poco percepibili e difficili da avvistare e rilevare. Anche la volpe frequenta la zona e vi ricerca le proprie prede così come pure l'allocco il quale è stato ripreso all'abbeverata e durante il bagno in orario diurno. Capriolo e cinghiale sono molto presenti e si aggirano in tutte le aree, sono state trovate loro tracce anche nelle zone dei lavori.
Un discorso a parte merita la scoperta del lupo, anch'esso fotografato in piena area "di lavoro". Il lupo è in fase ulteriormente espansiva in tutto il complesso appenninico romagnolo, con diversi gruppi residenti e molti individui erratici e in movimento tra i gruppi. Di recente arrivo anche nel Parco della Vena del Gesso, è evidente che un gruppo ha trovato rifugio nel territorio della cava visto che una femmina *alpha* in evidente stato di gravidanza è stata fotografata presso la pozza e un altro individuo presso il fiume. Si tratta di un dato di notevole interesse che accompagna quelli relativi alle altre specie, spesso fotografate con i cuccioli, a designare uno scenario di rifugio rappresentato dall'area in esame. Ulteriori indagini sarebbero da porre in essere per meglio verificare gli scambi tra questa e gli attigui SIC per la redazione di piani di gestione scevri da preconcetti e basati su rilievi ecologici reali.

X Congresso Italiano di Teriologia

Demographic parameters of two Savi's pine vole populations (*Microtus savii*) in agro-ecosystems

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Fossorial Savi's pine vole (*Microtus savii*) is the most widespread vole species of Italy that lives in open areas, orchards, forage and cereal crops. These characteristics make it an ideal model species in order to understand possible impacts of agricultural practices, including the use of plant protection products. However, data on population dynamics are seldom available, thus management plans are difficult to develop. This study therefore aims at filling this gap, carrying out a study on two populations in central Italy. To address these issues, from July 2014 to June 2015, two populations were monitored monthly by means of live traps in peach orchards (Imola and Foiano). Animals were trapped by means of live traps and were all individually marked. Data were analysed with the software MARK. Density values ranged from 8 to 32 ind./ha in Imola, and from 3 to 30.5 ind./ha in Foiano. Density peaks occurred in October in both study areas. In Imola survival was constant in juveniles (0.56±0.14) and showed a temporal effect in adults. In Foiano survival was constant both in juveniles (0.39±0.11) and adults (0.49±0.04), showing a sex-effect for the latter, with a slightly higher survival in males (0.51±0.06) in respect to females (0.47±0.06). Mean turnover rates of both populations were very high, with a time of residency usually no longer than two months. Both populations showed relatively small intra-annual fluctuations, but whether these are to be attributed to a phase of a multi-annual cycle is still to be ascertained. Neither population appeared completely stable, most likely due to both anthropic and natural features of their environment.
In Imola we also analysed the home ranges of 37 individuals, the animals for which we recorded at least 10 capture events. Our data show that there is no significant difference between sexes (520±81 m^2 female; 415±95 m^2 male) and that the mean home range size is 474±60 m^2.

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Study of the social relations of the Alpine marmot (*Marmota marmota*) in the Gran Paradiso National Park

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The analysis of interactions between animals of the same species is a relevant aspect of ethology and they allow to understand relational and structural dynamics behind this behavior. For the Alpine marmot (*Marmota marmota*), a species with high sociality, the relationships within the family are held through affiliative behaviors which are of three main types: mutual cleaning, playing and greeting. Instead, territorial defense and family hierarchy are implemented by marmots through competitive interactions.
In this work we describe characteristics of different family groups of Alpine marmot in terms of social cohesion and interaction levels among individuals of the groups. Moreover, we analyze which individual factors (age, body weight, sex, dominant position, etc.) influence the frequency and the type of interactions between animals.
This study belongs to a research project led by the Gran Paradiso National Park during which more than 250 marmots have been individually marked from the year 2006 in the study areas of Orvieille (2165 m a.s.l.) and Tzauplanatz (2283 m a.s.l.), in Valsavarenche (Valle d'Aosta). We analyzed more than 6000 social interactions carried out by almost 50 marked animals in the period 2013–2015. By using the software SOCPROG we calculate for each marmot and each typology the interaction degree, in order to represent the social structure of the different family groups. The effects of individual variables have been analyzed by using mixed models where the dependent variable is the individual interaction degree while the fixed factors are: the body weight, the animal status (dominant or dependent), the number of animals in the family group, the age, the sex, the year and date of the marmot's capture.
The results have great importance for understanding the social behavior of the Alpine marmot.

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First data on a female Apennine brown bear (*Ursus arctos marsicanus*) telemetry monitoring outside the Abruzzo Lazio e Molise National Park

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Even though telemetry monitoring is an essential tool to investigate a species ecology and to implement conservation actions, until 2014 only bears living in the Abruzzo Lazio e Molise National Park (PNALM) had actually been GPS-collared. The presence of the female F1.99 in the Natural Reserve Monte Genzana Alto Gizio (RNRMGAG) and the Majella National Park (PNM) encouraged the activation of a coordinated capture team aimed to equip with a GPS collar this individual. F1.99 showed confident/problematic behaviours only in a restricted period while for most of the time she behaved normally, so that data collected gave important and useful information on bear ecology and conservation outside PNALM.

Our scope is to present data on bear space use outside PNALM and to show the importance of telemetry monitoring to implement the best conservation actions possible. Our objectives are to describe the denning behaviour, describe the home ranges in term of size, seasonal overlap and protection status and show how a single radio collar-equipped female can help bear conservation.

F1.99 was captured using Aldrich foot snares and equipped with a GPS/GSM collar programmed to acquire 48 locations/day and 8 locations/day (low rate) respectively for 10 and 20 days/month. To describe denning behaviour we individuated the dates of entrance and emergency, the number and the location of denning sites according to the criteria used to describe bear ecology in the PNALM. To estimate home ranges we used the fixed kernel method with the hLSCV smoothing factor. In order to reduce the influence of autocorrelation in the utilization distribution estimate, we used only locations with constant time interval according to the low rate configuration. Due to hardware constraints, for the annual home range estimate we used only locations acquired at 6 hours interval. We defined four seasons according to the studies already conducted for the Apennine brown bear: spring (S, den emergence–31 May); early summer (ES, June–July); late summer (LS, August–September); Autumn (AU, October–den entrance).

The hibernation period lasted from 8 to 31 March for a total length >20 days, the minimum to link the activity reduction to hibernation needs. F1.99 used three denning sites located at a mean distance of 711 m: the first was used from 8 to 21 March, the second from 21 to 24 March, from 25 to 29 March she stood near a third site and from 29 to 31 March she started to abandon the area until meeting the criteria for hibernation ending. Two of the 3 sites used are located in a non-protected area while the last one is located few meters inside the RNRMGAG.

We estimated home ranges for three of the four seasons due to a collar failure at the end of September. The annual 95% home range size is 172.6 km^2 and seasonal 95% home range sizes varied from 90.6 to 212 km^2 (mean$\pm$SD=146.8$\pm$61.2). Seasonal 95% home ranges overlap varied from 47% to 55% (mean$\pm$SD=51%$\pm$4%) while 50% home ranges overlap varied from 0% to 28% (mean$\pm$SD=10%$\pm$16%). The 33% of the annual home range is located outside protected areas (PAs) while the portion of seasonal 95% home ranges outside PAs varied from 26% to 45% (mean$\pm$SD=36%$\pm$9%). The annual 50% home range is located inside PAs while seasonal 50% home ranges outside PAs varied from 0% to 52% (mean$\pm$SD=25%$\pm$26%).

F1.99 was captured on 3 March 2015 and this could have biased the hibernation analysis, as most of the winter is excluded from data collection. Anyway, we can say that at least for 23 days she showed an hibernation behaviour and that she changed denning sites. Considering the location outside PAs of the sites used, we can hypothesize that disturb could have been an issue and this stresses the need to augment the protection status of the non-PAs.

Home range sizes are higher than the mean and, sometimes, the maximum estimated for females in the PNALM but included in a size-range typical of high resource availability areas. The seasonal 95% home ranges overlap shows a degree of fidelity but the core areas poorly overlap showing the need to change the centre of activity in relation to the different season-related needs. The percentage of home range outside PAs suggests again that an adequate degree of protection should be guaranteed also in the non-PAs.

Even though F1.99 is only one of the minimum 6 bears present in the PNM-RNRMGAG in 2015 and even though data collected in September are biased by her problematic behaviour, her telemetry monitoring allowed the individuation of particularly important areas, the implementation of immediate conservation measures and the collection of strong data to stress the need to extend conservation efforts outside PAs boundaries.

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Population of mouflon (*Ovis aries*) of Zannone island: status, impacts and management

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Zannone is a small island in the Ponziano Archipelago and it is part of Circeo National Park. The extension is equal to 102.88 hectares and the coastal development is about 6 km. The mouflon (*Ovis aries*) was introduced in the island in 1922 for hunting purposes, with three couples from Sardinia. Introductions continued until 1971, with individuals from Turkey and the Balkans. The size of the population reached a peak of about 200 units around 1950 and a minimum of 20 around the 80s of the last century. In 1994 the estimated population was equal to 32–40 units, while the 2006-2007 survey provided an estimate of about 50 units. In 2015, it was again carried out a count of the population through the block-count method, adapted to the geomorphological characteristics of the island. The island has been so divided into 5 counting sectors, inside of which were used both sighting points and transects, for a total of 3 repetitions. The mouflon population structure was found to be composed of the following classes of sex and age: 34.7% of male sub-adults (2 to 3 years), 28.7% of adult females, 11.1% of yearlings, 8.5% of adult males (from 4 to 6 years), 7.4% of thin females, 6.5% of two-years males and 3.1% of adult males. The density is 41.2 units/100 hectares, with a standard deviation of $\pm$5.4 units. Although in a slight decrease trend compared to 2007, the density is high when compared with that of other Italian and European areas and the structure of the population appears to be seriously impaired, with predominant sub-adult and adult classes. The abundant density turns into a major impact on the island vegetation. In order to investigate these impacts, phytosociological surveys were carried out according to the method of Braun-Blanquet on three vegetation categories: a) holm dominance forest with *Erica arborea*, *Arbutus unedo* and *Pistacia lentiscus*; b) high maquis with *Erica arborea*, *Pistacia lentiscus* and *Daphne sericea*; c) garrigue, which alternates communities of *Cistus monspeliensis* and *Erica multiflora* to communities of *Cistus salvifolius* and *Lavandula stoechas*. The greatest impact is given by overgrazing which is reflected in the over-exploitation of fields located between the garrigue and the cliff vegetation, the low percentage of herbaceous species than wood ones, both in the forest and high maquis and the almost total absence of shrubs, seedlings and sprouts in the holm oak forest, resulting in lack of reforestation. Comparing the results of phytosociological surveys conducted in Zannone with those of ecologically similar islands, Ponza and Giannutri, it highlights an important floristic pauperization, especially of the Mediterranean evergreen oak woodland, inserted in Annex I of the Directive 92/43/EEC, as Habitat 9340 "*Quercus ilex* and *Quercus rotundifolia* forests". In Zannone only 6 species were detected, compared to the 13 found in Giannutri and 32 in Ponza. Mouflon impact on the island is due to a population density above the carring capacity, such as to justify management actions that open to two types of scenarios: a) maintaining the mouflon population through artificial feeding and protective actions (closed areas) for the most vulnerable and important plant communities; b) population removal action, as suggested by the Guide Lines of Istituto Superiore per la Protezione e la Ricerca Ambientale.

Data were collected as part of a service provided for the Circeo National Park within of "Azione di sistema trasversale - Impatto degli ungulati sulla biodiversità dei parchi italiani" funded by the Ministry of the Environment for the activities aiming at the conservation of biodiversity.

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Management or shooting? Dynamics in the last decade (2005–2015) of hunting, crop damages and vehicle collisions related to wild boar in ATC Perugia 1

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The wild boar is among the large mammals the one whose distribution and abundance is more subject to man-made manipulation. The species over the years has become a source of problems because it causes significant damage to agriculture, poses a threat to biodiversity and to road casualties. The mosaic of the different management types that characterizes Italy is not able to provide homogeneous criteria and the necessary overview on which a serious and effective species management should be based. The wild boar management outside of protected areas is almost completely dependent of hunting which, however, is not able to pursue the medium-long term goals defined in according with strategic management guidelines: in fact, in Italy the species in the last 20 years is steadily increasing and the distribution of the wild boar, the density, the structure and dynamics of populations, are mostly related to local hunting dynamics.

In the present study we analyzed the situation in the Ambito Territoriale di Caccia Perugia 1 in the last decade (2005–2015) evaluating the dynamics of hunters, crops damages, road casualties and hunting bags. Hunters registered in ATC Perugia 1 dropped by 31.1% with a decrease of about 3% per year, going from 19393 to 13356. To this negative trend will not escape the wild boar hunters, which nevertheless increased, albeit slightly, their weight on the total of the hunters (28% in 2005 against 31% in 2015). Hunting bags change from just over 4000 wild boar in 2005 to more than 6500 wild boar in 2015, with strong annual fluctuations higher than 60% (difference in percentage of animals culled in two consecutive years). In addition, the availability of wild boar per hunter (ratio between number of animals culled and the number of wild boar hunters), has doubled in the study period. Starting from the hunting seasons 2011/12 and 2012/13, years in which they were made the most abundant hunting bags (respectively 7600 and 9200 animals culled), both compensation of crop damages, both road casualties have gone to decrease, due to a probable reduction in the number of wild boar. However, in the last year, wild boar hunting bags and agricultural damage returned to grow, doing hypothesize that the removal wild boar population, after 2011–2012 (where it has reached the maximum number of wild boar killed), has not been sufficient to keep the population under control and the value of killing threshold above which goes to affect the population appears more than 7000 units. These data are confirmed by the incomplete realizations of the plans for the years 2014-15 and 2015–16 which provided (based on the estimation of the population through Leslie removal method) respectively 7809 and 7976 units. Finally, through an examination of the mandibles, it is observed that 55% of the units has taken more than a year of age, and among them many as 62% have more than two years, while only 20% of the total is made up of small within 3 months of age: all data characterize with slight variations, throughout the decade under review.

Available data suggest a trend of general growth of the species, whose dynamic growth in the long term it is only occasionally affected by the hunting removal. When the removal plan assigned is not respected (frequently the hunter tends to self-limit hunting to maintain a portion of population for future hunting season), back problems relating to damage to agricultural crops. If the hunting is not already an effective tool to regulating the wild boar population, continuous reduction of hunters, will open more critical scenarios than those current situation in the species growth dynamics. The creation of smaller management units directly connected to the local wild boar population size and the development of a professional hunting able to assist the regular hunting, especially in areas not suitable to the species and forcing the removal of the youth classes, they appear indispensable tools in view future management, which must also be based on reliable scientific data on the size population.

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Vocal response of the golden jackal (*Canis aureus moreoticus*) to the soliciting of the intensive acoustic surveys

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Acoustic surveys are widely used on wild canids studies (such as grey wolves, jackals and coyotes) since many years. This method presents some disadvantages and limitations especially when used on newly established populations or when the target of the research includes young individual in dispersion, however, the data potentially collectable from a consolidating population are much more than the only estimation of abundance and individuals distribution. This study analyzes five calling stations data distributed for virtually covering a 15 km^2 wide area. These stations were about 2 km far from each other. The study area is situated on the Karst near Gorizia on the South East part of Friuli Venezia Giulia. In this area there is a consolidated population of golden Jackal which was constantly monitored for over five years. The acoustic survey is a technique based on the emission of a broadcast jackal howl by a speaker to trace the individual that respond with the aid of a compass and the estimate of the distance. Using this method the estimation of the number of the individuals is quite inaccurate and it changes with different environment conditions but it became more precise if it is used for a period long enough to allow a statistic elaboration of the collected data, furthermore it could surface many information not detectable with a single desultory calling.

Overall, 23 emission days were carried out during 2014–2015, distributed on two seasons (on summer, from April to June; on winter: from October to December). Three consecutive days of emission and twelve of silence were done in each session. If Jackals did not answer to the first emission, five more emissions, called trials, with a three minutes pause between them will be done. Different kinds of howling were used to test if there would have been different responds: an individual howling and a choral one, alternating them every three days. It was so possible to collect a great number of responses and to test different hypothesis. By analysing the distribution of answer distances (with 124 total responses, x=5.3 per night) it has been possible to determinate that only within 600 meters away from the tester it is possible to know the number and the position of the individuals with enough accuracy, even if the maximum range of audibility is about 1000 meters. This range depends on the area morphology and on the vegetation cover and on the anthropic and natural background noise. The average of the individuals detected per emission day is higher during the winter session (winter x=6.25, st.d.=0.59; summer x=4.64, st.d.=0.57).

More than half of the whole responses were detected during the first trial (56%). As the trials increase the responses progressively decrease (34% on the second trial, 14% on the third and 6% on the fourth). No jackal responded to the fifth trial session. It is possible to observe a correlation between the trial and the vocal response length. The longest response, in seconds, were on the first and second trial (x=13.0 at the first, x=14.5 at the second) and progressively they became shorter (x=11.6 at the third, x=6 at the fourth). The average response length, in seconds, changes if the individual is alone (x=10.91, st.d.=6.27) or in a pair (x=15.25, st.d.=8.84) or in a group (x=18, st.d.=7.58).

Alone jackal responses are shorter than the pair and the groups ones. It has been observed that the number of responses of an individual alone to a single broadcast howl is equal to the choral one (33 response to the single broadcast howl and 32 to the choral one). A pair of jackals responds more if the broadcast choral howl is used (12 choral responses to a single *versus* 15 choral responses to a group), but the difference is not significant (Pearson χ^2=0.354, p=0.838). The collected data in this field survey could offer both important considerations about Jackal behaviour in relation with acoustic survey and a more conscious planning of the monitoring which uses this method of survey.

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Habitat selection and vocal behaviour of the golden jackal (*Canis aureus moreoticus*) on the karstland

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The knowledge of the habitat uses from a species are essential to understand his requirement and potential expansion in an area. However, about the jackals we have only few information about locally habitat use, so this study wants to fill this gap. The jackals have a high plasticity for food and habitat resources requirements. There are population settled in the marshy wetland and others in semi desert. A local study in depth is useful as term of comparison with the macro habitat of distribution of the species This study analyzed the data of five calling station distributed with a mutual distance of 2 km to virtually cover an area of 15 km^2.

The studying area is located on the Karstland plateau, Gorizia Province, in the South East of Friuli Venezia Giulia Region – Italy; this area holds a consolidated population of golden jackal already subject of same study and constantly monitored for five years. The acoustic survey is a technique based on the emission of a broadcast jackal howl by a speaker to trace the individual that respond with the aid of a compass and the estimate of the distance. With this method the distance estimate is inaccurate and variable for the weather conditions but became more accurate if carried over a sufficiently long period to allow a statistical elaboration of the data collected. Furthermore can emerge undetectable information which a single occasional emission. They were performed totally 23 days of surveys, in 2014–2015, spread over two season (summer session from April to June and winter session from October to December). In every session, we repeat tree days of emission interspersed by 12 days of silence. With this approach, we can collect a high numbers of responses (124 times the individuals have responded to stimulation afterward 23 days of survey which an average of 6.25 st.d.=0.59 in the winter session and average 4.64, st.d.= 0.57 in summer session). Through the use of a QGIS tool was possible to mapping the point of jackal response. Analyzing the distribution of the responses was determined the possibility to estimate with accuracy the position of the individuals only within a range of 600 m from the operator even if the radius of audibility is about 1000 m. It was chosen to extract only the response under a radius of 600 m around the calling station (65 points overall) for the habitats description and randomly extract 250 point under this area as term of comparison. Around this point was created a 100 m buffer and intersected with a landscape cartography (Carta della Natura). Every quadrant is characterized using the FRAGSTATS software for analyzing the landscape pattern witch an index kit to evaluate the structure and composition of the landscape.

It was found that the prevalent classes in this area are the sub Mediterranean arid meadows 62.4%, the medium European bushes 32.8%, oak forest 4.43%; other classes are not very representative.

The surfaces of the individual habitats measured over the buffers with a radius of 100 meters, of the responses and the random points were compared using the non-parametric test Kolmogorov-Smirnov. From the test emerges a positive selection effect for the arid meadows (p=0.001) and negative selection effect from the bushes (p=0.007). The less representative classes have not significant relationships. The study area showed a high homogeneity in terms of composition of soil covers but appeared significant the attitude of the jackals to prefer the grassland sites instead of brushy sites.

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"La valle del lupo", a sustainable tourism project: a new way for wolf conservation?

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The population of the Apennine wolf (*Canis lupus italicus*) is experiencing a phase of expansion of distribution and population growth following the agreed protection since the 70s and the development of an extensive network of protected areas. Since the middle of last century, with the increase of wooded areas and densities of large herbivores, with the depopulation of mountain areas, the ecological conditions have brought about the recolonization of the wolf population in a large part of its old areas. In the last twenty years, the conflict with the livestock and hunting world, which sees the wolf as a potential danger, has had great media response, especially with the development of social networks.

It is clear that the preservation of the wolf can no longer ignore the correct work of communication being carried out through all possible channels; such as education of large sections of society (in particular children), preparation of coexistence strategies shared by the various stakeholders and the involvement of local governments in conflict management processes.

The Human dimension is necessary for maintaining a favorable status for the wolf. The development of a sustainable tourism, based on the environmental values of the area, can contribute to the protection of this large carnivore, using it as a "renewable resource" able to stimulate and support economic development processes, especially in the areas considered "marginal".

The "La valle del lupo" project, sponsored by the Council of Fabbriche di Vergemoli (Lucca), which takes its cue from the return of the wolf in the valley of Turrite Cava (partly included in the Apuan Alps Regional Park), operates on two fronts: 1. the informing and educating of the local population (with special evening courses, encounters, and meetings with stakeholders, environmental education projects for schools) and 2. the promotion of the territory, involving actions on the development of nature tourism (themed trails, special signs, involvement of local accommodation and environmental guides). Finally a classroom will be set up in an "alpeggio" still used by small livestock farms, with panels dedicated to the wolf and the pasture of mountain sheep. All aimed at creating a virtuous path leading to wolf conservation and sustainable development of valleys and ancient villages otherwise marginal compared to the main tourist circuits.

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Il progetto di monitoraggio dei Chirotteri nelle cavità del Sulcis Iglesiente

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Il progetto di monitoraggio della presenza di Chirotteri nell'insieme delle cavità naturali ed artificiali del Sulcis Iglesiente ha preso il via grazie alla Regione Autonoma Sardegna, Assessorato della difesa dell'ambiente, e all'ex provincia di Carbonia Iglesias, Area dei servizi ambientali, che ne copre le spese attraverso i fondi la Legge Regionale n°4 del 7 agosto 2007 "*Norme per la tutela del patrimonio carsico e speleologico delle aree carsiche e per lo sviluppo della speleologia*". Ne sono parte attiva i gruppi speleologici soci della Federazione Speleologica Sarda, principalmente quelli del Sulcis Iglesiente, ma che ha visto a titolo di volontari anche altri appassionati dell'intera isola. Lo scopo era di aggregare attorno all'idea di verifica delle presenze dei chirotteri i possibili interessati, formarli e con il loro aiuto iniziare una ricerca volta alla cartografia delle colonie e raccogliere maggiori informazioni fenologiche su quest'area di notevole importanza biospeleologica.

Ulteriore scopo è quello di individuare i maggiori *hot spot* di diversità a sostegno della conservazione di questi ambienti ipogei e, nel caso delle miniere, guidare in senso conservazionistico anche il loro futuro *management*.

Il Sulcis Iglesiente geologicamente è impostato principalmente su litologie paleozoiche terrigene e soprattutto su quelle carbonatiche dove si sviluppano imponenti complessi carsici con 1289 grotte ad oggi accatastate. Queste stanno dando importanti contributi in senso geologico, mineralogico, speleologico e biologico e la loro conservazione è una assoluta priorità. In egual misura il Sulcis Iglesiente è una delle aree minerarie di maggior importanza d'Italia e la fortissima attività di scavo nei secoli ha lasciato come eredità innumerevoli cantieri minerari in sotterraneo, con centinaia di chilometri di gallerie che, oggi dismesse, sono divenuti habitat ipogei importanti e che spesso albergano consistenti gruppi di chirotteri. La Sardegna è ricca di 21 specie di chirotteri e quasi tutte frequentano in varia misura gli ipogei, o vi passano buona parte dell'anno in rifugi riproduttivi e di svernamento.

Il progetto, dopo momenti di formazione di tutto il gruppo composto da 35 volontari, ora sta esplorando alcune cavità modello e raccogliendo nel contempo suoni all'uscita delle stesse.

Sono state scelte in prima battuta le cavità di Cava Romana (Nuxis), Corona Sa Craba, (Carbonia), Grotta dei Fiori, (Carbonia), Sa Crovassa de Pranu Pirastu (Domusnovas), Grotta di San Giovanni (Domusnovas), dove mensilmente un gruppo misto di volontari si reca a verificare le presenze. Sono state rilevate colonie o presenze di *M. schreibersii*, *Myotis punicus*, *M. emarginatus*, *Rhinolophus euryale*, *R. mehelyi*, *R. ferrumequinum*, *R. hipposideros*, tutte specie di Allegato II della Direttiva Habitat.

Il progetto vuole dare importanza alla realizzazione di lavori in *team* che permettano un proseguimento nel tempo e l'acquisizione di importanti informazioni sulla bioecologia delle specie coinvolte e dei loro ambienti, utili per formulare adeguati piani di gestione e conservazione.

X Congresso Italiano di Teriologia

European pine marten (*Martes martes* Linnaeus, 1758) sightings in North Latium (central Italy)

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In this study, preliminary data on the micro-distribution of the European pine marten in Northern Latium (Viterbo administrative province and adjacent areas in Rome province) are presented. A database including records collected from the first half of the eighties of the 20th century to 2015 has been arranged. Data come from unpublished, absolutely opportunistic and random observations carried out by the senior author (MZ) and from other random field observations, kindly made available by the staff of the protected areas, professional zoologists, PhD students and non-professional experts (ca. 50 researchers). Municipality, site, elevation, habitat, date of collection, kind of record and source of information were given for each entry. 129 records have been collected (10 uncertain), 88% of them assembled in 2008–2015. Photographic documentation (23 records) and geographic coordinates (13) have been gathered when possible. Data were mapped in 1:500000 map with 10×10 km UTM grid. Although records have been obtained without sampling design and identifications are based on external morphology, a first elaboration of them has been done excluding those uncertain. Three categories of records have been recognized: direct observation (39 records), camera trap (35), road-kill (45). Five kind of habitat have been coarsely identified: forests, including reforestations (76); ecotones of forest and open habitats (20); shrubs (11); urbanized (6) and cultivated areas (3). The European pine marten occurs in the Viterbo Province (∼3612 km^2, 19% of which wooded; 322000 inhabitants; 89 inhab./km^2), at least in 20 municipalities out of 60. Although the distribution of records is patchily and additional standardized field research is necessary, the data collected support the more or less stable presence of this species, mostly in the NW (Vulsini Mts, Rufeno Mt) and SE (Vicani Mts, Cimini Mts) more forested hilly sectors of the study area, apparently disregarding the coastal stretch and areas immediately behind.

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Are Alpine marmots getting fatter throughout the years?

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The effect of climate changes on biometrical traits in wildlife species is of undoubted relevance for conservation biology. Among these, individual body mass is particularly susceptible to variations as consequence of changes in external environmental conditions.
Here we investigate the variation in body mass in Alpine marmot, a hibernating rodent inhabiting the alpine meadow and active from April to October. We used mixed models to analyse body mass data on marked marmots during 9 seasons (from 2007 to 2015) together with data about the individual (age, dominance status, etc.) and climatic parameters in different years, registered by a local weather station.
Data were collected within the ongoing Alpine marmot long-term project organized by the Gran Paradiso National Park in Valsavarenche (AO), where around 280 marmots have been marked, studied and monitored since 2006.
The analysis shows a positive increase in individual body mass throughout years suggesting that climatic change may affect an important biometric trait in one of the main species of the Alpine ecosystem. Further studies are considered to monitor the species and potential changes at the population levels.

X Congresso Italiano di Teriologia

Some Sika deer (*Cervus nippon*) recently hunted and spotted free-ranging in the Emilia-Romagna's region (and out of it) question the management of Italian red deer (*Cervus elaphus*) population

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The European red deer (*Cervus elaphus*) population of "ACATER West" management unit (northern Appennines, Emilia-Romagna) is the target of censuses since 2009, and under hunting plan since 2012. In February 2011, a deer was tentatively identified as Sika deer *Cervus nippon* (case 2) and after several attempts of trapping it was finally shot by Provincial officers in March 2012, in the same locality where it was observed one year before. The details of the event, involving an adult male of 72 kg weight, have been reported in a poster presented at the VIII National Congress of Theriology (ATIt, Piacenza, 9–11 May 2012), where the case was described as the first in Italy. Only after the meeting a previous case was brought to our knowledge, having occurred in October 2010 in the province of Bolzano (case 1) also concerning an adult male of 73 kg. In October 2012, in Modena Apennines, a second deer (case 3) was identified as Sika deer *Cervus nippon* (male, 113 kg) at the same site of the previous killing. After case 2 an investigation, particularly challenging and often frustrating, has started in order to identify farms or detention sites of Sika deer from which the animals could have originated, suspecting finally for escaped farmed red deer actually hybrids. Afterwards, thanks to information gathered following the circulation of the poster presented at the VIII National Congress of Theriology, it was reported that 3–4 most likely pure Sika deers escaped in late '90 in the mountains of southern Emilia-Romagna region, and photographic evidence were collected of groups of Sika deer in the wild in Parma Appennines in the 2000–2005. Additional concern for the "ACATER West" (Deer Interprovincial Hunting Area) red deer population derives from the existence of potential hybrids among the deer purchased in early '80s by Bolognese, Tuscanian and Umbrian deer farmers from Scotland where a variable degree of hybridization (*Cervus elaphus* × *Cervus nippon*) between Scottish Red deer and Sika deer has been reported. Notoriously these deer farms bred for 40 years and produced for both meat purposes, restocking and reintroduction in wild. Some of these potential hybrids (at least two known cases, totaling a ten of individuals) have escaped from captivity and settled near the site where Sika deers were hunted. Moreover, a bolognese deer farm is also known as supplier for the red deer reintroduction program in Reggio Emilia Apennines area (mid 90s). Morphological variability due to potential hybridization and degree of introgression may make difficult to distinguish between Sika and red deer, consequently, it was proposed to the Emilia-Romagna Region and Modena Province the implementation of an information sheet (made with the coordination of ISPRA) concerning the morphological characters of *Cervus nippon* and its similarities and differences with *Cervus elaphus* and *Dama dama* (Fallow deer), with the aim of raising awareness in the volunteer staff in charge of biometric monitoring at the control centers. The circulation of information has in fact contributed to alert several hunters and volunteers of "ACATER West", with interesting feedbacks and rising questions regarding cases deemed suspect or doubtful. Among these, the case of a Sika deer (case 4) hunted in January 2014 in the province of Parma, in the northern peripheral area of the "ACATER West" management unit, very near the site where Sika deers were photographed ca. 10 years before. As in the past, the animal was an adult male, weighting 123 kg. The collaborative attitude of the hunters and of the hunting units ATC MO2 and PR5, PR8 and AFV Lama allowed to start collecting samples to keep for genetic tests from other 5–6 hunted deer suspected to be hybrid Sika × Red deer, with the aim of determining if they were pure species or hybrids. In fact, in the meantime, a genetic surveys based on microsatellites analysis (thanks to a Czech laboratory) on both cases of Modena, has determined they were hybrid of three species-subspecies (*Cervus nippon*, *Cervus nippon hortulorum*, *Cervus elaphus*). This encouraged the Emilia Romagna Region to suggest to contiguous ACATER (West and Central) an adjustment in their multiannual plans, including a program of informations and upgrade for wildlife technicians, biometric operators and hunters, as well as a validated protocol for the identification and removal of suspicious deer hybrids by hunters engaged in selective hunting of cervids. Thanks to this further development of the information campaign, some specific characteristics of a Sika hybrid were noted in a doe (case 5) rescued 26 May 2015 in the bolognese Apennines due to its strong visual deficit. Finally, we present some considerations and proposals regarding the possibility of defining national guidelines for the prevention and management of the phenomenon in deer farms and in the wild.

X Congresso Italiano di Teriologia

Ecological association between wild rodents and ixodid parasites in woodland sites of the Abruzzo Region

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Wild rodents are widespread hosts of many ecto-parasites, particularly they play an important role for the maintenance of tick cycles in several ecosystems. In typical rodent-tick associations, tick burdens are a complex function of many extrinsic and intrinsic factors.

The aim of the study was to investigate the host-parasite ecological association between wild rodents and ticks in some woodland sites of the Abruzzo region. Specific objectives were: 1) to define the community of ticks associated to wild rodents compared to those found in the environment, and 2) to verify which intrinsic factors of rodents (e.g. species, sex, age, body mass, reproductive state) influence tick presence and burden.

We used Sherman live traps to capture wild rodents along transects in 21 forested sites from July 2014 to November 2015. Each captured rodent was sedated to collect data about species, sex, age, body mass and reproductive state. Rodents were then inspected for feeding ticks that were collected and stored in 70% ethanol for later identification. We also used the "dragging" method in a subsample of 8 sites to collect free-living "questing" ticks in order to compare the seasonality of their presence in the ecosystems and on mice.

Tick abundance, prevalence, intensity and aggregation on mice were calculated for each type of host. Tick load was also analysed with specific logistic regression and negative binomial models, ranked using AICc (Aikake's Information Criterion corrected for small samples), to asses which characteristics of rodents play a role in affecting the presence and the number of ticks.

A total of 115 rodents (84 *Apodemus flavicollis*, 23 *Myodes glareolus* and 8 *Apodemus sylvaticus*) and 282 feeding ticks (most were *Ixodes* spp.) were analysed. The data confirmed that ticks are highly aggregated on hosts. The total mean abundance of feeding ticks was 2.45 (95% CI: 1.84–3.26) with the highest prevalence (83%) for *M. glareolus*.

Comparing the seasonal patterns between free living ticks (210 individuals collected by dragging) and feeding ticks on mice, we found different immature stages distributions (larvae and nymphs) in summer, probably due to the differences in life cycles of generalist tick *Ixodes ricinus* and specialist *Ixodes acuminatus*.

We found that the body mass of rodents is positively related to the presence and numbers of ticks, suggesting that large body masses have a higher probability to be infested by ticks. We found a positive effect of active reproductive state on the presence of ticks and we also found, as expected, that male mice had greater tick loads than females.

Our study highlights the important role of wild rodents as hosts to *Ixodes* sp. ticks in several selected areas of the Abruzzo region, considering also the influence of some intrinsic factors. These results contribute to better explain the ecological aspects of rodents-ticks associations and have possible implications for understanding the epidemiology of some tick-borne diseases in a region of central Italy.

X Congresso Italiano di Teriologia

Lupo al lupo: un progetto didattico e percorsi partecipati per la gestione del conflitto al confine tra Lazio, Umbria e Toscana

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Nell'area di Acquapendente sin dagli anni '60 sono segnalate presenze sporadiche di lupo; quest'area ha visto negli anni una progressiva evoluzione naturale delle foreste e ha registrato dagli anni '70–80 un aumento della densità di ungulati, in particolare capriolo, e negli ultimi anni ricerche condotte dalla R.N. Monte Rufeno hanno permesso di studiare ed evidenziare la presenza stabile di un nucleo riproduttivo sul confine con l'Umbria, confermando quanto ipotizzabile sulla base di precedenti modelli di idoneità ambientale. Negli ultimi anni sono altresì aumentate le segnalazioni di predazione su bestiame e la notizia e il rinvenimento di esemplari di lupi uccisi, di cui il Museo del fiore già da testimonianza in collezione dal 1995.

Al fine di ridurre il conflitto sociale incipiente e in prospettiva sul piano della sostenibilità e della coesione sociale il gruppo di lavoro ha cercato e attivato strategie e percorsi partecipati: 1) attività didattiche e piccole esposizioni sia in museo che per la Festa contadina ad Acquapendente in agosto per parlare della presenza, del ruolo ecologico e della possibile convivenza con il predatore; 2) adesione nell'aprile 2014 al PALALUPO TOUR promosso dal *Wolf Appennine Center* del Parco Nazionale dell'Appennino Tosco Emiliano e realizzazione di incontri e una tavola rotonda sul tema "Il lupo tra mito e realtà"; 3) selezione e coinvolgimento di cittadini sensibili nei programmi di ricerca e in particolare nelle sessioni di *wolf-howling*; 4) interviste aperte e ricerche d'archivio per valutare il conflitto allevatore-predatore e per raccogliere la tradizione orale di visioni e vissuti delle popolazioni locali attorno al lupo; 5) coinvolgimento delle associazioni locali per sviluppare una riflessione a più sguardi sul tema del selvatico e del rapporto con gli elementi naturali.

Queste azioni hanno prodotto una aggregazione spontanea di diversi soggetti e di un gruppo di cittadini simpatizzanti e interessati a stimolare una *governance* territorale volta alla riduzione del conflitto.

Attualmente sul piano educativo il gruppo di lavoro sta predisponendo il programma didattico "Lupo al lupo" pensato come esperienza pilota per le scuole locali con gli obiettivi di esplorare il mondo e l'immaginario legato a questa specie e di sviluppare di giochi di ruolo. Il progetto prevede anche un corso di aggiornamento per insegnanti con il quale sviluppare un percorso sul contatto con la natura come strumento per favorire il benessere e l'acquisizione di *life skill* e competenze di relazione.

In parallelo si sta cercando di promuovere la nascita di una rete locale di allevatori per favorire la diffusione di buone pratiche e di cani idonei alla guardiania mediante un allevamento locale ENCI e per fornire informazioni sull'accesso ai finanziamenti PSR e POR. Questa azione porterà ad incontri pubblici per un confronto aperto i con i diversi portatori di interesse e le realtà del territorio e l'attivazione di possibili sinergie ad esempio con le esperienze di progetti Life attivati sul tema in aree vicine (Medwolf, Mirco, Wolfnet2.0) e più lontane (Wolfalps).

X Congresso Italiano di Teriologia

Livestock depredation by puma in the argentine Espinal, southern Buenos Aires province

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Livestock predation is one of the most frequent sources of conflict between humans and carnivores throughout the world, representing a serious problem for wildlife conservation. We investigated the conflict between puma (*Puma concolor*) and ranchers in two counties (Villarino and Patagones) of Buenos Aires Province (Argentina).

During the last decades, the natural habitats of this region have been dramatically changed by the expansion of livestock raising and agriculture, that are the principal sources of income for local people. This study aims to characterize puma predation and describe its effects in this region.

Data were collected from 2007 to 2015 through three different techniques: semi-structured interviews, workshops with ranchers and kill site inspections. We found a difference in number and type of predominant livestock between the two counties. Cattle is the most common species (40.3%) in Villarino, whereas in Patagones sheep are more abundant (32.7%). Nevertheless, sheep (adults and lambs) were the most predated livestock (22% in Villarino and 65.8% in Patagones) in both counties. Possibly due to the different livestock husbandry in the two counties, a difference occurred in number of calves killed (8% in Villarino and 3.5% in Patagones). Therefore sheep predation by puma produced a higher economic loss in Patagones than Villarino, whereas cattle predation showed the opposite trend.

Most of the predation events occurred in the cropland (48%), probably due to the major presence of sheep in this habitat type, followed by shrubland (26%), grassland (17%) and grassland with shrubs (9%). Predation events occurred mostly at night (95%), when human activities are less frequent, and far from anthropic areas (roads and villages). No seasonal predation pattern was recorded on domestic sheep, whereas the predation on calves was concentrated during the calving season (from September to December). The mean number of livestock killed for each predation event differed according to the method we used to collect the data. For example, in Patagones (the only county in which we have enough field data) this number was 33.7 individuals considering the data from semi-structured interviews and workshops and 5.3 when we used only data collected directly by field operators through kill sites inspection. If we consider only ranches (n=23) with puma predation and where we know the exact number of individuals present and depredated, the average of livestock killed by pumas (n=25.1), represents a minimum proportion of the average of individuals presents (n=504.6).

Interviews, workshops and kill site inspections showed that local people and pumas have a coexistence conflict in the study area, due to puma attacks on domestic herds. We believe that the informations collected throughout structured questionnaire, in conjunction with our analysis on puma's kill sites, is a very precious source of data about species and conflict with ranchers. Based on the informations given by them, it's possible to get sufficient evidences to create a general scenario of the reality in a specific area. The results showed that there is a difference in husbandry practices between the two counties. The majority of depredation events occurred in croplands at night and sheep were the mostly depredated with no seasonal depredation pattern. Depredation on calves was less frequent and concentrated during the calving season. There is a considerable difference in the average of individuals depredated comparing informations recollected by ranchers and kill site inspections data. In this sense, we are aware that maybe an enlarged perception by some ranchers, could result in an overestimation of their herd losses due to puma attacks. Despite the conflict between human and puma could lead some serious problems in terms of livestock depredation and economic loss, our results indicate that is necessary consider in systematic way the impact of puma predation in our study area to avoid bias related with the methodology or the operators and, in this way, to contribute to establish management measures that could decrease the conflict.

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Buzzing in case of emergency: distress calls in greater mouse-eared bats

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Distress calls are broadcast by bats when being physically constrained, such as when attacked by a predator or handled by people. Although they have been studied in a few species, more work is needed especially to unveil their function. In our work, carried out in western Sicily in 2015, we set out to provide a first description of distress calls in greater mouse-eared bats *Myotis myotis*. We caught 20 subjects (13 adults and 7 juveniles) on roost emergence and recorded the calls they emitted when handled with a D1000X Pettersson real-time bat detector. Calls typically had a multiple component buzz structure and were audible to the unaided ear. We found that frequency of maximum energy (FMAXE) as well as start (SF) and end (EF) frequencies were all higher in adult calls than in juveniles. Adult calls also showed a smaller number of both harmonics and pulses in a buzz. Body size, expressed as forearm length (FAL) influenced the number of pulses in a buzz. FAL showed a positive correlation with body mass, FMAXE, EF but a negative correlation with call duration and number of pulses in a buzz. Although our study is preliminary, based on our first findings we suggest that distress calls convey individual information to conspecifics and perhaps elicit differential behavioural reactions (such as mobbing) in colony members. Besides increasing sample size in analyses, our next step will be to carry out behavioural tests in the field to explore the function of distress buzzes in greater mouse-eared bats.

X Congresso Italiano di Teriologia

One, no one, or one hundred thousand: how many wolves are there currently in Italy?

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Large carnivores in Italy and other European countries are protected by law to ensure their long-term conservation. Estimates of abundance and demographic trends of their populations are crucial for implementing effective conservation and management strategies, such as those suggested in the newly-developed Action Plan for the species. However, it is challenging to obtain basic demographic parameters for elusive species such as the wolf (*Canis lupus*). Monitoring wolf populations by standard field methods or non-invasive genetic approaches requires huge human efforts and have never been carried out at a nation-wide scale. Aiming to obtain a first approximate estimate of wolf distribution and abundance in Italy, we developed a systematic review procedure to analyze published data obtained from a variety of sources. We deduced relevant information on wolf presence and numbers from 20 peer-reviewed studies or official reports, and from 241 Standard Data Forms of Natura 2000 sites in Italy, referring to the period 2009—2013.We estimated the species abundance by combining the number of individuals reported in each study area with the values obtained by multiplying the estimated number of packs for the average pack size. Comparing our estimates with those previously reported, we evaluated the qualitative trend of the population for each of the two management units: Alps and Apennines. Results showed the occurrence of approximately 321 wolf packs in Italy, corresponding to 1269–1800 wolves, possibly still underestimated. The Apennine sub-population seems to be almost the double in size (with ca. 1212–1711 wolves in the period 2009–2013) compared to previous estimates (600–800 wolves between 2006 and 2011). The Alpine sub-population, despite its ongoing eastwards expansion, appears rather stable (with 57–89 wolves), although recent updates from the WolfAlps LIFE project indicate a slightly higher abundance. Overall, the current wolf population size and trends seem favorable, although the species is still locally threatened by widespread poaching and accidents. These results represent the first estimate of abundance for the whole Italian wolf population in the last 40 years, and well match with those more recently elaborated for the National Action Plan using other statistical approaches. Such information are crucial to implement sound conservation actions, especially in areas where conflicts with human activities are more intense.

X Congresso Italiano di Teriologia

"Raccoons phone home" from a National Park in central Italy. But where to call? Genetics help!

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The raccoon (*Procyon lotor*) is an omnivorous mammal from North-America. Introduced in central Europe during the twentieth century, it was recorded in Italy for the first time about fifteen years ago in Lombardia. In our country, the raccoon was legally imported and sold, both as pet and animal fur, until 2006, when it was included in the national list of animals potentially dangerous for health and public safety, and whose detention was forbidden (Decreto del Ministero dell'Ambiente del 19 aprile 1996). In 2014 raccoon was listed as an invasive alien species by the European Union (CE Regulation 1143/2014). Several reproductive units are today present in northern Italy, and others are expanding elsewhere. These animals are highly adaptable to both natural and human-inhabited environments, show high reproductive rates and are strong competitors for native species. They can also transmit diseases to both pets and wildlife. Recently, some isolated reproductive units have been observed in the Foreste Casentinesi National Park (Tuscany, central Italy). Biological samples were collected from three raccoons (two dead and one captured alive) found inside the National Park or along its borders. Samples were submitted to DNA analysis in the Forensic Genetic Laboratory of the Istituto Zooprofilattico Sperimentale delle Regioni Lazio e Toscana to ascertain their possible kinship with five individuals hosted in a nearby Zoological Center, from where they could be escaped. Three additional raccoons from two different captive nuclei in Italy were collected and analysed for comparison. We genotyped all the individuals at five highly polymorphic nuclear markers (Short Tandem Repeats, STRs), obtaining the proportion of shared alleles between samples. In pairwise comparisons between the three raccoons found inside the Park and those hosted in the Zoological Center we found a percentage of shared alleles ranging from 50 and 90%. Same comparisons between the individuals found inside the Park and the three raccoons from two different captive nuclei in Italy showed a percentage of shared alleles ranging from 0 and 40%. This indicated that it was more likely that the three raccoons found in the Park area were related to the individuals of the Zoological Center (from where they, or their close relatives, probably escaped), rather than being related to the raccoons from two different captive nuclei in Italy. Further investigations are still ongoing by the CTA-CFS personnel of the Park, through the collection of signs of presence (sightings, carcasses, camera trapping images) in a geodatabase. Eradication plans of the species from the Foreste Casentinesi National Park are planned for the next future.

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Stato delle conoscenze del lupo *Canis lupus* in Puglia

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A distanza di circa 15 anni dalle prime segnalazioni del lupo in Puglia, oggi ci si pone la necessità di fornire un quadro conoscitivo chiaro e quanto più possibile esaustivo dello status della specie nel territorio regionale.

Il lavoro di sintesi è stato ottenuto sulla base delle informazioni disponibili, integrando dati relativi ad un periodo di tempo che va dal 2007 al 2016. Nello specifico sono stati considerati: (a) i risultati del 2014 e del 2015 del Progetto "Convivere con il Lupo: conoscere per preservare" condotto dal Dipartimento di Biologia dell'Università degli Studi di Bari, in collaborazione con il Parco Nazionale del Gargano (PNG) e con il Parco Nazionale dell'Alta Murgia (PNAM), integrando il metodo del fototrappolaggio, il monitoraggio genetico, il *wolf howling* e l'analisi delle denunce di predazione su capi domestici; (b) l'archivio di fototrappolaggio del PNAM (dal 2010 al 2014) relativo al Progetto di "Monitoraggio dei Carnivori"; (c) l'archivio di fototrappolaggio del Dipartimento di Biologia dell'Università degli Studi di Bari nei territori del PNG (dal 2009 al 2013); (d) l'archivio di fototrappolaggio dell'Ufficio Territoriale per la Biodiversità (Corpo Forestale dello Stato) di Martina Franca (TA) relativo alla Riserva Naturale Orientata Murge Orientali (TA) e alla Riserva Naturale Biogenetica Stornara (TA) nel biennio 2014–2015 (e) l'archivio della Regione Puglia, Dipartimento Agricoltura, Sviluppo Rurale e Tutela dell'Ambiente, relativo alle denunce e agli indennizzi per eventi di predazione su capi domestici (dal 2007 al 2013) nei territori al di fuori delle aree protette; (f) l'archivio dell'Istituto Zooprofilattico Sperimentale della Puglia e della Basilicata (IZS) relativo alle carcasse di lupo pervenute dal 2010 al 2015; (g) l'analisi della bibliografia e (h) il ritrovamento di carcasse (dal 2007 al 2015).

L'analisi integrata dei dati a disposizione ha permesso di ottenere una carta tematica di distribuzione della specie in Puglia, caratterizzata dalla colorazione di celle di dimensione 10×10 km, usate come riferimento dall'Agenzia Europea per l'Ambiente, sovrapposte a ortofoto di Google Earth. Le celle sono colorate in blu quando riferite ad aree con presenza regolare di nuclei e accertata attività riproduttiva, in rosso quando indicative di aree con presenza regolare e in giallo quando caratterizzate da presenza irregolare dovuta a individui isolati o in dispersione. Inoltre, nei due parchi nazionali pugliesi, grazie all'applicazione di metodi utili ad ottenere parametri di abbondanza (Progetto "Convivere con il lupo: conoscere per preservare", biennio 2014–2015), sono state ottenute delle stime di consistenza della popolazione.

La carta tematica mostra come attualmente il lupo in Puglia è distribuito in circa il 30% del territorio regionale. La distribuzione è uniforme sul Promontorio del Gargano e in tutte le aree montuose e collinari del versante occidentale della regione, dal Sub-Appennino Dauno, sino all'altopiano delle Murge di nord-ovest e di sud-est, compreso il territorio delle gravine dell'arco jonico. Le aree dove è confermata l'attività riproduttiva ricadono interamente nei territori dei due parchi nazionali: nel 2014, all'interno del PNG sono stati stimati 4 branchi riproduttivi e una popolazione minima di 20 individui e nel 2015, 5 branchi e una popolazione minima di 24 individui; nel PNAM invece sono stati stimati 2 nuclei riproduttivi in entrambi i periodi e una popolazione minima di 12 individui nel 2014 e 10 individui nel 2015.

Tuttavia l'assenza di "celle blu" al di fuori dei perimetri dei parchi nazionali è verosimilmente dovuta alla mancanza di un campionamento specifico e di un piano di monitoraggio durevole.

Infine, è meritevole di particolari attenzioni per via dell'alto grado di antropizzazione e il forte indirizzo turistico, la presenza oramai accertata di nuclei stabili nell'area delle Murge di sud-est o "Murgia dei Trulli", un territorio apparentemente poco vocato al mantenimento di popolazioni vitali di lupo e caratterizzato dalla presenza diffusa di attività zootecniche a conduzione brada e semibrada (allevamento della vacca podolica e del cavallo murgese).

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Metapopulation processes and occupancy of water voles in a rice-dominated landscape

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The water vole *Arvicola amphibius* is a species nearly threatened in Italy; however our knowledge on its distribution and ecology is limited. The species could be decreasing in the Po Plain, due to the changes in the landscape and the degradation of waterways, but so far studies are lacking. We therefore investigated the species in some residual wetlands near the Po River, in the provinces of Vercelli and Alessandria, and along the channels connecting thee areas. The landscape outside the wetlands was dominated by intensive agriculture, especially paddy fields We recorded signs of the species presence along transects and analyzed the collected data with occupancy models to evaluate 1) the presence and distribution of the species in these wetlands and in channels that connected them; 2) derive an occupancy model that expresses the probability of the species presence; 3) evaluate some environmental parameters that may affect the presence of the species. The wetlands, surveyed in summer and fall, were Palude di San Genuario, Fontana Gigante, Ghiaia Grande and the Garzaia di Valenza; these are natural reserves managed by the Parco Fluviale del Po e dell'Orba. Transects were established inside the reserves and outside at increasing distances along the four cardinal directions where irrigation channels were present. Each transect, 300 m long, was divided into twelve parts of 25 m: six of them were surveyed for sign of voles presence while six alternating were skipped. During the survey data on five variables were collected: season, shore cover, soil type, presence of coypus and garbage. The typical latrines were the most common sign of presence and were therefore used for the analysis. In Palude di San Genuario animals were also live-trapped. Totally 59 transects were monitored, most of them between San Genuario (40 transects) and Fontana Gigante (13). Here the water vole was found inside the two reserves and along transects connecting the two areas. The species was also recorded in the Garzaia di Valenza where it was possible to survey only two transects; the species was not detected at Ghiaia Grande. The AICc approach to model selection revealed the importance of an earthy substrate of banks and the presence of grass. An earthy substrate allows a better excavation of dens and galleries, while the grass cover provide shelter for the animals. The proportion of sites in which the species was actually found (naïve estimate=0.14) was largely less than the estimate proportion of sites occupied according to the model (0.76), indicating a probable better distribution of the species in respect to our results. Palude di San Genuario and Fontana Gigante probably act as source areas for the water vole. A trapping activity in Palude di San Genuario and occasional observations in the two areas revealed the presence of the species in different ponds. The species was also recorded in the channels connecting the two areas, indicating a possible exchange between the two (sub)populations. The species distribution shrinks during fall, when many secondary channels are left without water and voles retire mainly in the residual wetlands. The monitored wetlands resulted important for the conservation of the species in this rice-dominated landscape. The animals in the two reserves of Palude di San Genuario and Fontana Gigante were probably part of a metapopulation, maintained by these source areas and connected through the channels used for irrigation.

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Economic benefits from the presence of brown bear in the Alps: a marketing approach

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The conflicts between humans and wildlife are often an issue for conservation projects, especially those dealing with large mammals in highly anthropic landscapes. The sustainability of a conservation project in the long term is possible only when both scientific and socio-economic evaluations are taken into account. In the Autonomous Province of Trento (PAT), Italy, the successful reintroduction of the brown bear (*Ursus arctos arctos*) is creating conflicts with the resident human population. Most of the issues are of economical nature, because the bears damage livestock, crops or honey farms and the owners of such activities are completely refunded by the PAT. The amount of the damages reimbursed and the costs of management are often used as an argument by the people that cannot accept the presence of this carnivore in the area. Although the bears do make damages to be reimbursed, they can also provide local economical benefits, as it happens in North America and Japan, where the species attract eco-tourists who are willing to pay to attend bear-watching tours or simply to share the forests where these animals live. Lately, in Trentino, some enterprises are beginning to offer bear inspired tours, despite the very low probability of a sighting, just exploiting the species appeal. The brown bear is a very charismatic mammal, that appears often the cover page of nature magazines, and that people often relate to wilderness and habitats in good health. In the Alps, the brown bear is present only in Trento Province and Slovenia, contributing to promote the image of Trentino as a high biodiversity spot at the point that the BBC has compared it to Yellowstone in the documentary "Predators in my backyard". This work try to asses the economic value of the brown bear as a marketing promoter for Trentino. Italian broadcasting companies often produce reports about the animal, and the BBC documentary has been broadcast worldwide conveying a positive image of Trentino, an advertising that Trentino had not paid for. This paper presents an original application of the Advertising Value Equivalent (AVE) method. The method is used to assess the advertising value of a sample of bear appearances in Italian newscasts and documentaries from 2011 to 2015. Results offer an overview of the magnitude of the value of the brown bear in television. If the Trento marketing company would have created an advertising campaign on the channels and time in which the bear was on air, it would have paid 2,5 million Euros in 2011 only. In all the five years of investigation, the AVE largely exceeds the amount of the reimbursements. Although we are aware that this figures cannot be viewed as the real value of the species, this evaluation method can be used to highlight the economic benefit that the brown bear can produce for its territory and can provide an additional contribution to the complex discussion with managers and stakeholders.

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A pilot study in monitoring a beaver *Castor fiber* population in Zasavića special reserve, Serbia by phototrapping

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The European beaver *Castor fiber* Linnaeus, 1758 formerly inhabited almost the whole Eurasian region but the excessive hunting has led to the almost complete disappearance of this rodent. At the beginning of the 20th century there were only eight surviving relict populations (Halley and Rosell, 2002). The small nuclei relicts were the source for numerous reintroductions realized throughout the continent and now beaver is present in most of European countries (McDonald et al., 1995; Halley and Rosell, 2002). Similar situation occurs in Serbia were in 1999 an immigrant beaver from Hungary was found and it was the starting point for national reintroduction project. In the period of 2004–2005, 75 beavers from Bavaria were release into the Obedska Bara and Zasavica Special Reserves (Ćirović et al., 2007). In order to understand if the monitoring procedure with phototrapping can be reliable for monitoring population of the beaver, in the last week of August 2015 seven traps were positioned in three different position along 3.5 km of the main river banks and 3.5 km of banks of a tributary channels. Each trap had been set with PIR sensor with an interval of 10 seconds and a video length of 20 seconds. Three session of trapping were performed: in the first the 7 traps were active for 2 days as well as for the second and 3 days for the third with a total of 47 nights/trap (as a trap didn't work in a session). On a total of 920 video in 381 of them 15 vertebrate *taxa* were recognized: Rodents – *Castor fiber*, *Rattus* spp., *Apodemus* spp., *Arvicola terrestris*, Carnivora – *Mustela putorius*, *Vulpes vulpes*, *Felis catus*, Aves – *Ardea purpurea*, *Nycticorax nicticorax*, *Ixobrychus minutus*, *Alcedo atthis*, *Anas* spp., *Rallus acquaticus*, *Fulica atra*, Passeriformes spp.. The most common species recorded was *Rattus norvegicus* (48.56% on the total) and the second the *C. fiber* with a mean of 18.33% of videos, ranking between the 44.47% in the first session, 10.53 in the second and 0 in the third. *M. putorius* reached 5.82% and, although present in the Reserve, the Otter *Lutra lutra* wasn't caught during the sessions. During session 1, a 5% of the images can be determined as young beavers, as in August there is still a strong difference in the size of the animal born in this spring. We also calculated the time between the setting of the traps before dusk and the first beaver video that was 2.60 hours in session 1 and 3.07 for session 2. Placing cameras in front of the slipway surely is very effective in order to have a rapid assessment of beaver presence, demonstrating that session 3 was in an area recently abandoned by the rodents. In 24 cases the videos showed beavers transporting plants to water and was in all the cases corn stalks, the main food of the local population during summer. The results of this pilot research shows that methods could be implemented in the close future to achieve more information about phenology and behavior of the species in this so recently colonized human dominated landscape, where agricultural land use leave to natural vegetation just a belt along the main banks of these rivers in the plain.

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Prey availabilty for *Puma concolor* in three habitats of the argentinian Espinal

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The puma *Puma concolor* is the top predator throughout most of the Americas, especially in the Southern Cone of the continent. Categorized by the IUCN as "Least Concern", is among the most widespread and adaptable felids. Nevertheless, habitat destruction and hunting has brought pumas to ecological extinction in vast regions of central Argentina. The Espinal is a mosaic of grasslands and shrublands that is heavily under pressure due to radical transformations of its natural habitats. Habitat loss due to agriculture and retaliatory killing for predation on livestock have caused a great reduction not only in puma populations but also in those of its native prey. The objective of this work is to evaluate the availability of the wild preys of pumas in the three main habitats of the Espinal: cropland, grasslandand, and shrubland.

To estimate prey availability we performed line transects equally distributed among the three habitats. Transects were made during winter (78 transects, km) and summer (80 transects, 1028 km) of 2014. The prey species that we counted were: *Lama guanicoe* (90–140 kg), *Rhea pennata* (15–25 kg), *Dolichotis patagonum* (9–16 kg), *Lepus europaeus* (an introduced species, 1.5–6.5 kg), *Eudromia elegans* (0.4–0.9 kg), and *Microcavia australis* (0.2–0.5 kg). For each habitat and season, in addition to the number of individuals/km, we estimated an index of the total availability of prey biomass, multiplying the mean number of specimens recorded in transects by their average live body weight.

Grassland showed the largest biomass in both seasons, with 13.6 and 12.4 kg/km in winter and summer, respectively; cropland presented a biomass of 11 and 9.4 kg/km and shrubland reached only 3.3 and 5.4 kg/km. Using parametric or non-parametric ANOVAs after normality and homogeny tests, we found a variation between the three habitat types only for the biomass of prey (Levene's test $p<0.05$). No significant difference was detected for the number of individuals and season (Levene's test $p>0.05$). Shrubland represented the most divergent result, probably accentuated by a greater difficulty to spot small prey associated to its denser vegetation than in the other habitats. However, grassland was the only habitat with presence of *L. guanicoe*, an ungulate that is the preferred prey of pumas in this region. The scenario produced by our results opens new perspectives in the construction of a map of the priority habitats for the conservation of puma and their overlap with the human uses, which will help to predict areas of potential conflicts and design mitigation measures.

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Analysis of the current status of anticoagulant resistence in Norway rat (*Rattus norvegicus*) in italian populations

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The norway rat, *Rattus norvegicus*, as well as other synanthropic rodent species, is an important pest and it is essential to find efficient strategies to control wild populations. The introduction of the anticoagulant compounds in the early 1950s produced a significant change for rodent control practices. However, after some years, first resistance events were observed in wild rodent populations. In the norway rat, anticoagulant rodenticide resistance is mainly associated with mutations in the third exon of the Vitamin K epoxide reductase complex subunit 1 (VKORC1) gene. Because of these mutations, rats may lose their susceptibility to rodenticides and become resistant. The identification of the resistant wild populations is very important to improve the control practices and to limit the damages due to a not adequate use of the anticoagulant rodenticide. Studies on anticoagulant resistence in wild populations have been made in many European and extra-European countries, but are completely lacking for Italy. In this preliminary work, the anticoagulant resistence in the Italian wild populations of *R. norvegicus* is tested searching mutation (SNPs) of the third exon of the VKORC1 gene known to be associated with the anticoagulant resistance (resistance SNPs, r-SNPs). We obtained sequences of the third exon for 25 norway rats from seven italian regions (Abruzzo, Calabria, Campania, Lazio, Piemonte, Toscana and Sicilia) and San Marino Republic. We didn't find r-SNPs in any individual. The work is yet very preliminary to make any hypothesis and will be continued increasing the number of individuals for each region. Furthermore, we are planning to sample norway rats from areas of use/not use of anticoagualnt rodenticides to understand if there is a relationships with the use/not use of those compounds and the presence/absence of the mutations known to confer the resistance.

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First data on Finlayson's squirrel *Callosciurus finlaysonii* (Horsfield, 1824) expansion in Campania, Italy

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Introduced on the Tyrrhenian coast of Basilicata in the mid-80s, the Finlayson's Squirrel is widening more and more its range, colonizing the southern part of Campania and the Cilento, Vallo di Diano e Alburni National Park (PNCVDA). Already in 2004 the species occupied coastline in the Region Basilicata an area of 26 km^2 (Bertolino and Aloise, 2004), in the following years despite being monitored, has made its appearance in Campania, expanding rapidly on the coast, but also in the internal areas. The data collected over the past two years as part of a project monitoring the mammals of the Park have shown that an exponential growth and distribution in a few years has exceeded 150 km^2 in the province of Salerno, involving several Sites of Community Importance. In light of the pace of expansion and given the context of vegetation and environment, the Squirrel variable within a few years could colonize the vast deciduous forests of Mounts Cervati and Sacro making futile any enforcement action. In addition to the potential impact on biodiversity the damage to chestnut woods and olive groves of the area would be incalculable. In the areas of recent colonization of the species it is causing damage to infrastructure (electrical and telephone cables), agricultural activities, especially in orchards, but also to the vegetation with a massive bark stripping and consumption of fruits. Within this general framework it is necessary to monitor the species and a combined control action between the Region Basilicata, Campania and PNCVDA is fundamental, starting from the areas in close contact with the potential areas of expansion and simultaneously proceeding to its eradication in the source areas.

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Evolution and trends of the populations of *Canis aureus moreoticus* in Italy

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The present work outlines the evolution and trends of the populations of the European golden jackal (*Canis aureus moreoticus*) in Italy. This Eurasiatic species arrived in north-eastern Italy in 1984 (Veneto Region) and in 31 years of presence has expanded its Italian range of about 150 km westward, reaching Alto Adige only in 2013–2014 (Val Venosta, Bozen Province). A complete analyses of the data at 10-years intervals reveal that its current range is increasing, particularly in the last decade (2005–2015). The overall data indicates that the expansion waves of this jackal in Italy are clearly influenced by the already known expansion phases of the species in Europe, but in the last years the populations of north-eastern Italy turned out to be an autonomous source of expansion, thanks both to some long-lasting populations of the Karst of Gorizia and to the formation of new groups dwelling in the centre of Friuli Venezia Giulia Region (Pordenone Province).

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The presence of the wildcat in Val di Cecina

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The presence of the European wildcat (*Felis silvestris silvestris*, Schreber 1775) in the woods of Val di Cecina was rather uncertain, with only a few old records which were unreliable because lack of documentation made identification impossible. In the period 2014–2015 the presence of the felid in the Nature Reserves of Alta Val di Cecina was proved thanks to documentation produced using video and camera traps (these instruments are part of a monitoring action on a larger scale, in collaboration with Union Montana, CEA Alta Val di Cecina and the Province of Pisa, which focuses on the species *Canis lupus* in a number of protected areas), and to the discovery of a roadkill specimen. Val di Cecina, with its richly diverse and complex territory, low human activity and lack of industrial complexes and infrastructure, is certainly very suitable for this species. Although the above mentioned results are only provisional and improved documentation is to be envisaged through more timely and intensive monitoring, evidence suggests continued presence of a viable population of wild cat in the territory with a homogeneous distribution. The protection and preservation of this predator, at least locally, requires its habitat to be maintained unaltered, by preserving the heritage of protected areas in the territory of the Val di Cecina.

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Morphological traits in two roe deer populations hunted in north-western Apennine

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Roe deer is the most common cervid in Italy, and has been subject of many studies conducted throughout the years. In central Italy, in particular in the Apennine environment, roe deer stalking started at the beginnings of 80s and the informations gathered from the hunting bag have been given us essential informations regarding the status of roe deer populations. However, some areas showed a late colonization by roe deer and the information on the Apennine populations may haves some shortcomings. In La Spezia province, roe deer has been considered in terms of stable population starting from 2012. In the spring of 2012, we organized censuses to determine population density and then proceeded with the hunting. In the Massa-Carrara province roe deer has been managed and hunted since 1997. In both province a technical staff checked and measured every deer shot, taking biometric parameters. In this study, we showed the results of some morphological traits derived from roe deer hunted in the two province. Population density estimated in the two areas, with the same census method, is higher in La Spezia province (20.5 heads/100 hectares) than in Massa-Carrara province (16.6 heads/100 hectares). The average body weight of adult roe deer, both males and females, belonging to La Spezia province was higher than the average body weight of the adult roe deer, both males and females, populating Massa-Carrara province (Males: ATCSP=28.9 kg ATCMS=25.2 kg on average; Mann-Whitney U-test$_{males}$: Z=4.749, p<0.000. Females: ATCSP=24.6 kg ATCMS=22.3 kg on average; Mann-Whitney U-test$_{females}$: Z=2.039, p=0.041). On the other hand, in sub-adult age class only males showed a difference in body weight (ATCSP=23.8 ATCMS=21.5 on average; Mann-Whitney U-test$_{males}$: Z=3.025, p=0.002), while females showed no difference (ATCSP=21.0 ATCMS=20.1 on average; Mann-Whitney U-test$_{females}$: Z=0.835, p=0.837). We measured sub-adults and adults males antlers length and burr circumference. The antlers length and burr circumference, both right and left, showed differences in relationship to hunting area and age class. In the adult age classes left antler was 17.7 cm and right antler was 18.1 cm on average for roe deer deriving from ATC SP. Roe deer measured in ATCMS exhibited left antler of 15.4 cm and right antler of 15.3 cm on average. Statistical analyses confirmed this difference in relationship to hunting areas (Mann-Whitney U-test$_{left_antler}$: Z=2.760, p=0.006 - Mann-Whitney U-test$_{right_antler}$: Z=3.472, p=0.001). Sub-adults males, showed a similar size for both antlers (ATCSP: left antler=11.7 cm, right antler=11.5 cm on average; ATCMS: left antler=11.4 cm, right antler=11.2 cm on average. Mann-Whitney U-test$_{left_antler}$: Z=0.882, p=0,378; Mann-Whitney U-test$_{right_antler}$: Z=1.264, p=0.206). The burr circumference showed the same difference than antler length as follows. ATCSP adult male: left burr circumference=13.3, right burr circumference=13.3; ATCMS adult male: left burr circumference=11.9, right coronet circumference=11.9. (Mann-Whitney U-test$_{left_coronet}$: Z=3.187, p=0.001 - Mann-Whitney U-test$_{right_antler}$: Z=3.233, p=0.001). ATCSP sub-adult male: left burr circumference=7.8, right burr circumference=6.9; ATCMS adult male: left burr circumference=8.0, right burr circumference=8.0. (Mann-Whitney U-test$_{left_coronet}$: Z=0.953, p=0.341 - Mann-Whitney U-test$_{right_antler}$: Z=0.501, p=0.617). These preliminary results suggested a morphological influence of the hunting practice on the population, since in the zones where hunting activity started earlier the individuals showed some morphological traits with lower width compared to that of the individuals belonging to a population that has been hunted for shorter time. Further analysis are needed, especially in relation to vegetation patterns and consequent resources availability present in the two areas considered.

X Congresso Italiano di Teriologia

M'ammalia il Museo del Fiore: esperienze di comunicazione ed educazione attorno ai Mammiferi della R.N. Monte Rufeno

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Il Museo del Fiore è un museo civico naturalistico allestito nel 1995 in un vecchio casale rurale all'interno della Riserva Naturale Monte Rufeno che ha avviato una serie di strategie per realizzare un laboratorio territoriale per la sostenibilità e la divulgazione dei valori della biodiversità. Per questa finalità sono stati tarati allestimenti, con elementi interattivi e multimediali, e la costituzione delle collezioni non solo specifici sul tema del fiore e dell'entomofauna impollinatrice ma più ampiamente per documentare il patrimonio naturalistico locale e per offrire strumenti per una didattica esperenziale e percorsi educativi incentrati sulle relazioni. In questa chiave un filone di ricerca territoriale ed educativa è stato dedicato ai vertebrati e in particolare i mammiferi che offrono un approccio privilegiato con il mondo naturale per molte tipologie di visitatori.

Le attività di questi anni hanno portato il gruppo di lavoro del Museo e vari collaboratori ad allestire ed implementare una sezione sulle relazioni ecologiche con l'esposizione in Museo della mammalofauna locale e con un archivio multimediale di supporto e approfondimento; questo ha poi favorito la sperimentazione di percorsi didattici specifici sui mammiferi e sugli animali del bosco per scuole e diversi *target* (famiglie, associazioni, escursionisti…), cicli di conferenze e seminari per la divulgazione di ricerche. Attività costanti di sperimentazione negli anni sono stati gli *stage* primaverili degli studenti dell'Università della Tuscia nella riserva e zone limitrofe, percorsi estivi di approfondimento per gli studenti del Liceo scientifico locale sul riconoscimento di specie e corsi di aggiornamento per insegnanti rivolti alla conoscenza dei diversi ambienti del territorio.

Queste esperienze hanno portato a mettere a punto una serie di attività didattiche e di proposte laboratoriali con l'intento sia di far conoscere e approfondire aspetti della biodiversità locale ma anche per favorire occasioni di incontro, scambio e aggregazione presso il Museo. In questo quadro il Museo ha trovato l'interesse aderire dal 2011 alle iniziative di M'ammalia, il progetto promosso da ATit e ANMS, mettendo a punto per l'autunno un percorso tematico per accompagnare i visitatori lungo le sale del museo alla scoperta dei mammiferi. Ogni anno a seconda del tema nell'atrio del Museo viene proposto un animale come accompagnatore e guida speciale. Così negli anni abbiamo esposto un lupo, un capriolo, un pipistrello e anche una coppia di barbagianni con le loro borre e i micromammiferi predati.

Sulla base di attenzioni conservazionistiche valutate oportune di volta in volta si è proposto iniziative ed eventi collegati come ad esempio piccole mostre in città o le *Bat night* sono seguite all'iniziativa pubblica sulla conoscenza dei Chirotteri del territorio di Acquapendente realizzata con la collaborazione del progetto "Un pipistrello per amico" del Museo di Storia naturale di Firenze. Un ulteriore stimolo offerto per il coinvolgimento dei visitatori in percorsi di *citizen science* è stata la proposizione della APP di CSMON LIFE (`www.csmon-life.eu`) per segnalazione di mammiferi (in collaborazione con `www.therio.it`).

Molte delle proposte sperimentate sono state condensate nella caccia al tesoro naturalistica "A caccia di tracce" predisposta in più versioni e con prove dislocate in tutte le sezioni del Museo alla ricerca di indizi e informazioni sui mammiferi che vivono in Riserva e che verrà riallestita in occasione del X Congresso ATIt per i suoi partecipanti. Questa esperienza non è di tipo competitivo e ogni partecipante/famiglia ha la possibilità di completare un proprio percorso ma soprattutto di avvicinarsi al mondo degli elusivi mammiferi e della natura che li circonda.

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Bats of sardinian public forests

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The Sardinia island hosts a complex bat community with many species of conservation concern and one endemic species, the *Plecotus sardus*. Although in the past years the distribution of cave dwelling species has been studied in depth, less is known about bats of woodland habitats. As part of the drafting of management plans promoted by the Sardinian Forestry Agency (Ente Foreste della Sardegna), we studied bats presences in 20 public forests, covering a total of about 50000 ha: Limbara Sud (3600 ha), Monte Olia (2370 ha), Terranova (2160 ha), Sorilis (1060 ha), Sos Littos-Sas Tumbas (2160 ha), Crastazza (2540 ha), Usinavà (1040 ha), Fiorentini (1580 ha), Anela (1530 ha), Monte Pisanu (2090 ha) in northern Sardinia, Montes (4660 ha), Uatzo (610 ha), Alase (1950 ha), Montarbu (2800 ha), Monte Arci-Santa Giusta (390 ha) in central Sardinia, Montimannu (3170 ha), Gutturu Pala (930 ha), Marganai (3670 ha), Is Cannoneris (4740 ha), Settefratelli (6410 ha) in southern Sardinia.

Acoustic survey concerne over about 320 km of transects, mostly by cars, and 69 listening points, of 10 minutes each, were carried out on 10–20 September 2012 in all the forests. Information about species presence by netting for 14 forests and by roost surveys in 8 forests, realized in previous years, were provided by the Centro Pipistrelli Sardegna. Authonomous roost surveys were also performed in 4 forests.

We get over 1800 contacts from acoustic surveys, belonging to 13 species: *Rhinolophus hipposideros*, *Rhinolophus mehelyi*, *Myotis punicus*, *Myotis emarginatus*, *Pipistrellus kuhlii*, *Pipistrellus pipistrellus*, *Pipistrellus pygmaeus*, *Nyctalus leisleri*, *Nyctalus noctula*, *Hypsugo savii*, *Eptesicus serotinus*, *Barbastella barbastellus*, *Miniopterus schreibersii*, *Tadarida teniotis*. We also recognize *Pipistrellus nathusii* (only one contact, identified by social calls) and *Nyctalus noctula* (two contacts) which presence in Sardinia is not confirmed by captures or other sources in recent literature. 8 species were recorded by netting (*Rhinolophus ferrumequinum*, *M. punicus*, *M. emarginatus*, *P. kuhlii*, *P. pipistrellus*, *H. savii*, *E. serotinus*, *M. schreibersii*, *T. teniotis*) and 8 in roost surveys (*R. ferrumequinum*, *R. hipposideros*, *M. punicus*, *M. capaccinii*, *P. pipistrellus*, *P. pygmaeus*, *H. savii*, *M. schreibersii*).

The most widespread species are *P. pipistrellus* (observed in all the forests), *M. schreibersii* (in 95% of sites, not detected in Usinavà), *P. kuhlii* (in 90% of sites, not detected in Sorilis and Terranova) and *H. savii* (in 85% of sites, not detected in Sorilis, Fiorentini and Gutturu Pala).

T. teniotis was detected in 70% of sites (Monte Olia, Terranova, Crastazza, Fiorentini, Anela, Monte Pisanu, Montes, Montarbu, Monte Arci, Montimannu, Gutturu Pala, Marganai, Is Cannoneris e Settefratelli), *P. pygmaeus* (Limbara Sud, Monte Olia, Terranova, Uatzo, Montarbu, Monte Arci, Montimannu, Gutturu Pala, Marganai, Is Cannoneris, Settefratelli) in the 55%. *R. ferrumequinum* (detected in 35% of sites) and *R. hipposideros* (in 40% of sites) were both observed in Limbara Sud, Fiorentini, Montes, Gutturu Pala, Marganai and Settefratelli; *R. hipposideros* was also observed in Anela and Monte Pisanu, *R. ferrumequinum* in Montimannu. *M. punicus* was observed in Crastazza, Anela, Monte Pisanu, Montes, Montimannu e Gutturu Pala (30% of the sites). *M. emarginatus* (Sos Littos, Uatzo, Settefratelli), *N. noctula* (Fiorentini, Monte Pisanu, Montes) and *E. serotinus* (Monte Pisanu, Montes, Settefratelli) was detected in 15% of sites. *R. mehelyi* (Montes), *M. capaccinii* (Montes), *Pipistrellus nathusii* (Is Cannoneris), *N. leisleri* (Settefratelli) and *B. barbastellus* (Montes) were detected at a single site. In Crastazza, Montes and Monte Arci was also recorded (by acoustic survey) the genus *Plecotus*.

Considering only transect surveys, the most abundant species contacted was *P. pipitrellus* (9.9 ind./10 km; 48 pas./h), followed by *P. kuhlii* (4.6 ind./10 km, 21.8 pas./h), *M. schreibersii* (2.2 ind./10 km, 6.0 pas./h), *T. teniotis* (1.6 ind./10 km, 4.4 pas./h), *H. savii* (1.5 ind./10 km, 7.1 pas./h) and *P. pygmaeus* (1.3 ind./10 km, 1.9 pas./h).

The highest number of species, 12, was recorded in Montes Forest (in the Supramonte of Orgosolo); we also detected 11 species in the Goceano mountains, considering togheter the three forests of Fiorentini, Anela e Monte Pisanu. To be highlighted the presence of *B. barbastellus* in the Montes forest, a species considered very rare and localized in Sardinia, detected at Sas Baddes evergreen oak old growth forest. In Sas Baddes old growth forest we also recorded very high level of bat activities (from 18 up to 270 pas./h) and very high number of species (ten including bats detected on the edge of the forest).

Although further researches are needed to improve knowledge levels of single sites, our results show the great importance of forest habitats for Sardinian bats. Many forests, especially the older and more complex structured ones, hold rich bat communities including species of conservation concern or biogeographical importance.

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Zecche negli ungulati selvatici della Liguria

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Le zecche sono artropodi ematofagi obbligati a tutti gli stadi. Il loro ciclo biologico è caratterizzato da tre stadi di sviluppo separati da mute, precedute da pasti di sangue. L'ecologia, l'etologia e la fisiologia conferiscono alle zecche caratteristiche tali da rendere questi artropodi tra i vettori più importanti in Europa e potenziali serbatoi di infezione. Le malattie trasmesse da zecche si realizzano in cicli che coinvolgono un ospite, generalmente un animale selvatico, e un vettore biologico adattato a particolari ambienti bioclimatici, condizionando così l'ecoepidemiologia delle malattie trasmesse da zecche in un'area geografica. L'obiettivo del presente lavoro è stato quello di fornire indicazioni in merito alla pressione parassitaria presente nel territorio ligure; a tal fine, nell'ambito del "Piano di monitoraggio sanitario e attività di epidemio-sorveglianza della fauna selvatica nella regione Liguria", è stata effettuata una ricerca di ectoparassiti sugli ungulati selvatici abbattuti in Liguria (cinghiali, caprioli, camosci e daini) nel corso delle stagioni di caccia 2013–2014 e 2014–2015. L'indagine è stata rivolta in punti sensibili della carcassa, più glabre, in particolare coda ed orecchie. Una volta individuati all'esame macroscopico, gli artropodi sono stati rimossi con pinzette a punta fine e sono stati conservati in contenitori idonei in etanolo al 70%, in attesa di effettuarne il riconoscimento della specie. Sono stati campionati 2955 ungulati cacciati nel 2013–2014 (2232 Imperia, 327 Savona, 98 Genova, 241 Chiavari, 57 La Spezia) e 3719 nel 2014–2015 (2904 Imperia, 280 Savona, 112 Genova, 263 Chiavari, 160 La Spezia). Le zecche sono risultate presenti nel 4% degli animali monitorati nel 2013–2014, e nel 2.9% degli animali monitorati nel 2014–2015; in entrambi gli anni sono risultate differenze significative tra le ASL, (χ^2=249.395; g.l.=4; p<0.0001 e χ^2=50.373; g.l.=4; p<0.0001, rispettivamente). L'analisi della varianza multifattoriale effettuata tramite i GLM ha evidenziato differenze significative tra le ASL prese in esame per il numero di zecche rinvenute sugli animali esaminati (F=3.43, g.l.=3; p=0.020) e tra i due anni di campionamento (F=4.87, g.l.=1; p=0.030). Oltre a ciò è risultata significativa l'interazione tra i due fattori sopra citati (F=6.36, g.l.=1; p=0.012). In particolare, il numero medio di ectoparassiti per animale esaminato è risultato maggiore nelle ASL di Levante (La Spezia e Chiavari) e nel campionamento del 2013–2014.

Le specie rinvenute sono state: *Ixodes ricinus*, *Ixodes hexagonus*, *Rhipicephalus sanguineus*, *Rhipicephalus turanicus*, *Dermacentor marginatus*, *Haemaphysalis punctata* e *Haemaphysalis sulcata*. L'abbondanza di *I. ricinus* e *I. hexagonus* è risultata significativamente differente tra le specie di ungulati parassitate (F=11.67, g.l.=2; p<0.0001 e F=3.20, g.l.=3; p=0.027, rispettivamente); in particolare la prima specie è risultata più abbondante nel capriolo e la seconda nei cinghiali sub-adulti. L'abbondanza *R. sanguineus* è risultata significativamente differente tra le ASL (F=3.42, g.l.=3; p=0.021), con maggiori infestazioni nell'ASL di La Spezia; inoltre è risultata significativa l'interazione tra ASL, stagione di campionamento, sesso e classe d'età dell'animale parassitato (F=4.29, g.l.=1; p=0.041). Per la prima stagione di campionamento è stata rinvenuta, in particolare, in sub-adulti di sesso femminile e maschi adulti; nella seconda, invece, nei maschi subadulti e nelle femmine adulte. Anche *R. turanicus* ha mostrato variazioni significative tra le ASL (F=3.93, g.l.=3; p=0.011), inoltre è risultata significativa l'interazione tra l'ASL e stagione di campionamento (F=8.27, g.l.=1; p=0.005); in particolare, l'abbondanza è stata maggiore nell'ASL5 nella prima stagione di campionamento. L'abbondanza di *D. marginatus* è risultata influenzata dall'altitudine (F=4.81, g.l.=1; p=0.031) e differente tra le ASL (F=5.33, g.l.=3; p=0.002); inoltre è risultata significativa l'interazione tra ASL e sesso dell'animale parassitato (F=5.11, g.l.=2; p=0.008). In particolare, la specie è presente fino ai 1000 m di quota, soprattutto nella fascia mediterranea (0–400 m s.l.m.) nelle ASL1,4 e 5. Per quanto riguarda il sesso, è emerso che *D. marginatus*, a Ponente, nell'ASL1 infesta soprattutto gli ungulati di sesso femminile, fino ai 2000 m di quota, e i maschi dopo i 2000 m s.l.m.; nell'ASL3 Genova, i maschi della fascia compresa tra i 400 ed i 1000 m s.l.m. A Levante, sia nell'ASL4 sia nell'ASL5, infesta soprattutto gli animali di sesso maschile fino ai 400 m e viceversa nella fascia superiore (fino ai 1000 m). Per *H. punctata* sono risultate differenze significative in relazione all'altitudine (F=13.20, g.l.=1; p<0.0001), alla specie ospite (F=8.69, g.l.=2; p<0.0001) e alla stagione di campionamento (F=8.66, g.l.=1; p=0.004); inoltre è risultata significativa l'interazione tra specie ospite e stagione di campionamento (F=18.33, g.l.=1; p<0.0001).

Possiamo ipotizzare che le differenze di prevalenza riscontrate tra le due stagioni di campionamento siano dovute alle frequenti condizioni di copertura nuvolosa estesa ed ingenti quantitativi di precipitazioni piovose che hanno caratterizzato l'inverno 2013–2014. Questo fattore potrebbe aver diminuito lo stress dovuto alla disidratazione, solitamente conseguente alla peculiare lunghezza del periodo d'interpasto del ciclo biologico delle zecche. Inoltre, la piovosità maggiore a Levante, sia come quantità sia come numero di giorni piovosi, potrebbe avere ulteriormente agevolato la capacità delle zecche ad assumere acqua dall'ambiente, influenzandone positivamente il comportamento attivo di ricerca d'ospite nelle ASL 4 e 5.

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Application of three census methods for roe deer density estimation in a mountainous environment in the Apennines

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Roe deer is the most abundant and distributed ungulate in Italy, and it has a considerable impact over managed forests. To understand the impact and effects it can have on forest development, and plan a proper management, it is fundamental to know the abundance of its population in the area. During two consequent years, we tested 3 methods (drive census, pellet-group count, and camera trapping), for their precision and applicability in estimating roe deer abundance in a broadleaved mountainous forest in the Apennines. The density estimations were consistent across the methods (for year 2013: drive census 19.32±11.12 ind./100 ha pellet-group count 18.74±2.31 ind./100 ha and camera trapping 27.67±7.48 ind./100 ha). The methods showed to have a wide range of precision, with coefficient of variation estimation ranging from 0.12 (pellet-group count) to 0.58 (drive census). Drive census resulted to be the most demanding method, because of the high number of operators needed to perform the drives, and it returned the less precise results. Pellet-group count returned the most precise results, and requires a very small number of operators, but the sampling effort is quite high. Camera trapping (random encounter model, R.E.M) method resulted to have an intermediate precision compared to the other two methods, and the lowest sampling effort. The ease of field protocol of each method is considered and discussed, in the light of the increased probability of the census being performed by volunteers or technicians, in the next future.

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Monitoring of a population of wild boar (*Sus scrofa*) through Capture-Mark-Recapture techniques

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In recent years Human Wildlife Conflicts (HWC) have once more become a forefront issue due to the increased interest and sensibility of the public opinion towards environmental issues amplified by particular cases with strong media exposure, such as loss of agricultural productions, accidents and attacks, some of which with fatal consequences.

The management of the species is conducted, unlike what is done for Deer and wild Bovids, without scientific knowledge of the main parameters of population such as density, consistency and population structure. Furthermore, little is known on the exact movements of single family groups and on their composition.

Presently the best chance to gain insight on the abundant populations currently in Italy, starts from the analysis of the hunting bags, from experimental efforts derived from biometric studies, from harvesting seasonal woodland fruits and with censuses conducted through fixed point observation sessions of foraging sites.

The aim of this research, led with the contribution of the Regione Liguria State Department, is to gain knowledge on the populations of wild boar, in a specific geographic region characterized by the typical conditions of the northern Appennino mountain range. Furthermore new equipment and protocols were adopted to reduce the number of field operators involved in foraging operations of the capture sites and that allow marking the animals without the need of chemical restraining drugs.

The size of the ear-tags applied on the specimen allowed individual identifications through camera-trapping images.

In the Genova Province, from the spring of 2013, a monitoring project of the wild boar populations is in progress by means of capture sessions with mobile capture enclosures, individual tagging with numbered ear-tags, and subsequent recaptures. The intention is to estimate population size, evaluate activity rates and behaviors.

The project involved the University of Genova, the Regione Liguria State Department and the Provincial Police Department of Genova.

The study has been conducted in Valle Stura (Stura valley), area well representative of the Appennino environment of Liguria and bordering the Regional Natural Park of the Capanne di Marcarolo (Piemonte) in which similar activities were already in progress.

The study area, that covers a surface of about 4700 ha, 3800 of which covered by forests, has been divided in two sub-areas determined by their orography, topography and vegetational distinctions: The Berlino Valley and the Gargassa Valley.

Each or the capture enclosures was equipped with automated feeder, with the intent to concentrate the Wild Boar visits in the hours preceding the morning check routine of enclosures and camera-traps. This was intended to increase the recapture rate through photographic imagery that was then added to the harvested specimen reported during the hunting season and direct control operations.

The initial stage of the monitoring was conditioned by the wide infestation of the Ligurian Chestnut tree population by the Oriental chestnut gall wasp *Driocosmus kuriphilus*, which halted the vegetative growth of the plants and caused a reduction in fruit produce. These circumstances strongly conditioned the wild boar density and consequently the efficiency of the research activity.

During this initial stage 90 capture sessions were conducted which allowed to tag 97 specimen and to recapture 136.

55% of the marked quota was constituted by animals of less than 3 months ("striped") while animals older than 1 year ("blacks") represented around 35% of the quota.

The ratio between the age classes shows limited variations in the recaptured quota, for which the proportion of "striped" lowers to 51% while the "blacks" stand at 30% with a slight increase of the animals of intermediate age range ("reds"), from 10% to approximately 19%.

The inspection of seasonal hunting-bags showed that 12 marked specimen were harvested during the hunting season, two of which were shot more than 12 months after being tagged: in these specific cases the animals were harvested far from the capture site while in all the other cases this distance never exceeded 2 km.

The analysis of the camera trap recapture data showed how distinct family groups aggregate in a constant manner without any recombination in their composition.

It also was observed how different groups occupy the same areas at different moments. Effectively individuals of different family groups have never been captured in the same location during the same sampling days.

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Distribution and predation of wolf (*Canis lupus*) in the hill and coast Natura 2000 network of Chieti provence (Abruzzo Region)

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The objectives of the study is the investigation of the wolf pack distribution, the identification of the size (the certain minimum number per pack) and the predation strategy in a contest mainly rural/urbanized of recent colonization. This allows to provide a contribution to the knowledge of the phenomenon at the edge of the historical area, less known with respect to other recent expansion areas toward the north.

The main area under study is located in the province of Chieti, out of the larger protected areas, and along the coast and the hill region (0–1200 m a.s.l.) between the basins of the Sangro and the Trigno-Treste rivers, where the monitored 15 SIC sites are located (R.D.P. 2007–2013 Abruzzo Region, Measure 323 - Management Plans SIC Natura 2000).

Throughout the last decades the abandonment of large hilly areas and riparian zones, reoccupied by natural vegetation, has allowed firstly the return of preys (wild boar and roe deer), and later it allowed the return of the wolf, which gradually re-colonized the original distribution area even up to the coast.

The study was anticipated by the collection and verification of all previous information about the presence of wolves in the area, on the mortality events (car accidents, poisonings) including the collection of information on the historical presence of the wolf contained in the status registers (killings and localization of the later reproductive sites in 1800).

The study carried out between 2013 and 2015 is based on the integrated use of various techniques. An initial period of monitoring of indirect signs and wolf-howling (91 emission stations) is performed, with which the reproducing packs are identified; it is followed by the camera trapping activities, with 13 units throughout 1696 days of total recording (with an average of 31 days/camera trap/point). The cameras are installed accordingly in groups of 3–5 within each SIC (1 camera trap/400 hectares) and subsequently in the connection areas, using the country rural roads, river corridors (streams or ditches), with an activation protocol that allowed a uniform logistical control of the area under investigation.

In collaboration with the National Health System and the State Forestry Corps all predation on livestock (30 cases) were monitored from 2010 to 2015 and the information collected allowed to identify the most critical areas.

Individual recognition of three packs located in the hill area (100–500 m a.s.l.) was possible through the nighttime and daytime photos at the exiting or at the return from/to the nest site, using distinctive individual characteristics (size, height, nutritional status, etc.) or simultaneous photo-capture. The number of individuals per packs is between 4 and 6 units (reference to the late autumn period) with a numeric composition and combination of individuals highly variable in time (mean wolf/capture 2.1 ± 1.3). Each pack usually consists of two adults forming the reproductive alpha pair, by a sub-adult individual and from 2 or 3 young animals of the year. For two reproductive pairs the photo-capture space-time rate made in the surroundings the rendezvous sites is used to estimate the home range (2156 and 3003 hectares, MCP method).

The young units of the year are pushed away and enter the dispersion stage during the following winter being 8–9 months old. Subsequently the photo-capture rate of the young units decreases drastically: malnutrition followed by diseases along with the poaching and, in minor extent, with road investment, are considered to be the main causes of death.

In the high hill (600–1200 m a.s.l.) the detected number of units per pack is greater, in autumn it is between 6 to 9.

The stability and persistence of reproductive pairs during the autumn and winter is facilitated by the overlay of the core area with prohibited hunting areas (small nature reserves, repopulation areas and respect hunting zones) where packs are able to find simultaneously safe areas and food.

The predation strategy adopted against domestic animals, especially sheep, seems to be related to the position of fences and barns with respect to the hill morphology. It is found that in most populated rural areas between 100–500 m a.s.l., the attacks in 76% of cases comes from the base of the cultivated or grazed hill, where a ditch or a watercourse is usually located, and where the wolves are protected since they can safely move with preys.

Sub-adult solitary wolves are also occasionally located in highly populated areas of the valley floor, probably in dispersion (industrial area).

Similarly to what happens in the rest of Italy, also in these areas, throughout the last five years, a dynamic of territorial expansion through the lines of precise movement was developed. The colonization progressed from the high hills where the wolf was already present before 2010 through the river corridors toward the plain with a total of six reproductive packs, stable in the altitude range 100–500 m a.s.l..

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Season and habitat dynamics of rooting activity in the Circeo National Park

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Wild boar impacts on biodiversity and on natural or man-made ecosystems (such as agricultural environments) are related to rooting activity, consumption of vegetables and disturbance/direct predation on other animal species. At present the wild boar in the Circeo National Park, despite representing a component of the ancient native fauna, seems to be very abundant and its presence conflicts with the intense agricultural activity outside the Foresta Demaniale and the Promontorio. Furthermore, the wild boar represents a constant menace for collisions with vehicles. These threats require careful consideration of necessary actions to manage the wild boar population in the protected area to minimize negative impacts, also to the biodiversity. In order to monitor wild boar rooting activity we collected data in all forested areas (Promontorio and Foresta Demaniale including the wooded patch near Sabaudia) of the Protected Area, in two sessions: spring/summer and autumn. Seasonal monitoring was repeated in the same sample areas to check for any differences during the year. Rooting activity was registered in 25 macro-plots in which we covered 12 transects 100 meters long. Plots, randomly selected, represented 10% of the extension for each one of the three macro-areas (3 in Promontorio, 2 in forested patch near Sabaudia and 20 in Foresta Demaniale). One rooting event was considered as a depth of 15 centimeters, higher values of rooting were associated to multiples of 15 centimeters (for example, a rooting event 30 cm deep was assigned a value of two, and so on). The rooting value per plot is represented by the average of the contacts recorded in 12 transects of each plot.

Plots in spring/summer showed rooting values ranging between 2.00 ($\pm$1.32 SE) in the Promontorio to 9075 ($\pm$20.08 SE) in the Foresta Demaniale, while in the autumn we obtained values ranging from 9.58 ($\pm$3.80 SE) in the Foresta Demaniale to 111.67 ($\pm$32.26 SE) in the same macro-area, with statistically significant differences between plots in both seasons (Kruskal-Wallis, spring: χ^2= 117.17, p<0.01; autumn: χ^2=63.30, p=0.01). The post-hoc Dunn test with Bonferroni correction p=0.01) allowed the identification of plots with significantly different values of rooting (high intensity of rooting – low intensity of rooting): we observed a shift of rooting activity from the core portion of the Foresta Demaniale and from "Parco daini" sector to the northern portion of the Foresta Demaniale and Promontorio. These changes may be determined by the wild boars displacement in response to many factors: human disturbance, particularly intense in that time, research of areas with higher productivity of the forest, research of most suitable refuge areas or moving to areas near attractive crops. Moreover, the frequencies of rooting for the two sessions were analyzed in order to evaluate any preference in the choice of habitat for the rooting activities. Chi-square test demonstrated that wild boar operated a highly significant selection for habitat in spring (χ^2_4=750.75, p<0.001) and autumn (χ^2_4=373.78, p<0.001). With the simultaneous confidence intervals of Bonferroni we can state that the wildboar in spring/summer makes a positive choice for rooting activity for turkey oak and pine woods and negative choice for cork and holm oak. In autumn it is positively selected holm oak wood and negatively pine wood while the cork oak and Turkey oak categories were used consistently with availability without making a selection.

Data were collected as part of a service provided for the Circeo National Park within "Azione di sistema trasversale – Impatto degli ungulati sulla biodiversità dei parchi italiani" funded by the Ministry of the Environment for the activities aiming at the conservation of biodiversity.

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The open access Citizen Science platform iNaturalist to map the worldwide biodiversity: a focus on Italian terrestrial mammals

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Citizen Science is a valuable tool which helps scientists to discover and protect biodiversity with an high territory coverage, at the same time directly involving non-specialists in scientific activities. The main characteristics of a Citizen Science platform created to collect presence data perfectly overlap with the features of the platform iNaturalist (www.inaturalist.org). Through this platform, citizens can (i) learn about nature while connecting with other users or experts, (ii) take part to the scientific data collection and process, (iii) upload their data through an user-friendly platform and (iv) share open-access records with the scientific community.

We searched occurrence data on terrestrial mammals from iNaturalist and restricted our research to Italy. A total of 629 occurrence points with photos (confirmed by the community and revised by us) belonging to 80 species (70% of the total Italian terrestrial theriofauna) was collected, with observations uploaded between 17/07/2010 and 27/02/2016.

These data show a predominance of synanthropic and highly detectable species (e.g. *Myocastor coypus*, *Vulpes vulpes*, *Erinaceus europaeus*), as well as those more easily recorded through presence signs (e.g. quills of *Hystrix cristata* and diggings by *Sus scrofa*). Other records refer to species easily detected through the use of camera traps (e.g. *Meles meles* and *Capreolus capreolus*). By contrast, the platform shows some limits with cryptic species and the impossibility to ascribe the record to a certain species (e.g. *Apodemus* spp.; *Pipistrellus pipistrellus* vs *P. pygmaeus*).

Although current data do not cover the whole Italian peninsula and islands (e.g. the greatest part of the records come from Northern and Central Italy), most of the mammal species known to occur on the national territory has been spotted at least once. The ongoing increase of users of this platform leads us to suggest that iNaturalist represents an opportunity to obtain reliable records that may be useful to create updated maps of distribution of mammals in Italy in the next future.

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Selezione dell'habitat da parte della lepre comune (*Lepus europaeus* P.) in un'area della Pianura Padana nord occidentale

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Questa ricerca, attraverso l'analisi dell'utilizzo dell'habitat da parte di una popolazione di lepri in una zona protetta della provincia di Piacenza, in assenza, quindi, di disturbo dovuto all'attività venatoria, si propone d'individuare gli elementi chiave dell'habitat della lepre. Nello studio vengono analizzate le preferenze ambientali di un campione di 29 individui di lepre seguite con la radio-telemetria da gennaio a luglio del 2015, mettendole in relazione con i cambiamenti stagionali dell'uso del suolo, sia a livello generale sia a livello individuale. In questo modo si è cercato di comprendere come una popolazione di lepre possa reagire e adattarsi ai cambiamenti del paesaggio dovuti alla meccanizzazione e all'intensificazione dell'agricoltura.

L'approccio adottato può essere ricondotto sia al secondo, sia al terzo tipo di disegno sperimentale secondo la classificazione di Manly; infatti l'uso dei tipi di habitat è stato misurato per ogni individuo radio-marcato e la disponibilità è stata stimata sia per tutto il campione, definendo su basi oggettive i limiti dell'area di studio, sia all'interno delle aree vitali individuali. Inoltre, è stata valutata la differenza nella selezione dell'habitat tra i sessi e per le principali attività degli animali, vale a dire il riposo diurno e l'attività notturna principalmente di foraggiamento. Per quest'ultima analisi è stato utilizzato il primo tipo di disegno sperimentale, basandosi sulla distribuzione delle osservazioni effettuate durante i censimenti notturni. I dati per questo lavoro sono stati raccolti nel periodo compreso tra gennaio e luglio 2015.

Considerando le lepri per le quali è stato ottenuto un numero sufficiente di radio-localizzazioni e scovi (N=24) è stata stimata una superficie media delle aree vitali di 31.18 ha (DS=19.5), con una variazione da un minimo di 0.3 ha ad un massimo di 86.5 ha. Per quanto riguarda i singoli individui sono risultate delle differenze significative nei diversi livelli di selezione, sia per tutte le lepri, sia tra maschi e femmine. Considerando la selezione del macro-habitat per i siti di riposo diurno è risultato un uso significativamente diverso da quello atteso in base all'ipotesi nulla di un uso proporzionale alla disponibilità. Considerando la distribuzione dei *form* nei tipi di habitat contenuti nelle aree vitali e confrontandola con la disponibilità delle aree vitali stesse, è risultato un uso significativamente diverso da uno casuale (p=0,0000). A livello di micro-habitat, sono risultate differenze statisticamente significative tra *form* e punti di controllo. Per quanto riguarda le variabili categoriche del micro-habitat, l'analisi effettuata col test del Chi-quadrato per tabelle di contingenza non ha evidenziato alcuna differenza significativa tra siti di riposo e punti di controllo. Nel modello di regressione logistica condizionale (regressione di Cox) per dati appaiati sono state selezionate tre variabili con coefficienti di regressione significativi. L'analisi sulla selezione dell'habitat per l'attività notturna di foraggiamento è stata effettuata considerando la distribuzione delle osservazioni di lepri raccolte durante i censimenti notturni dei mesi di gennaio, febbraio e marzo.

I risultati del presente studio devono essere considerati in relazione alle caratteristiche ambientali generali dell'area di studio e alle densità stimate della popolazione di lepre che vi risiede. La ZRC di Borgonovo Val Tidone è una zona dalle buone caratteristiche ambientali per la lepre. Per quanto riguarda le densità della popolazione, queste si collocano a livelli medio elevati se paragonate ad altre situazioni italiane ed europee. Densità elevate aumentano la competizione intraspecifica negli habitat ottimali, aumentano l'uso di quelli sub-ottimali e mascherano di fatto la selezione dell'habitat. Pur mostrando un significativo scostamento da un uso proporzionale alla disponibilità, sembra che le lepri oggetto di questa indagine non selezionino particolarmente alcuni tipi di habitat rispetto ad altri. A livello di frequentazione, i diversi tipi di habitat appaiono ancor meno selezionati, segno che le lepri operano la loro selezione a livello di superfici e poi frequentano i tipi di habitat in base alla disponibilità. Maschi e femmine mostrano sostanzialmente le stesse modalità di selezione dell'habitat, pur con una meno evidente selezione generale da parte delle femmine. Per quanto riguarda i siti diurni di riposo, si può dire che vengono più utilizzati i tipi di vegetazione che offrono una maggior copertura e tranquillità. Queste caratteristiche rendono la lepre più mimetica e difficilmente contattabile dai predatori. Per ogni area vitale è stato calcolato l'indice di Shannon ed è stato messo a confronto con quello di 24 poligoni, scelti casualmente all'interno dell'area di studio. I risultati di questo studio possono dare indicazioni riguardo alla realizzazione di miglioramenti ambientali, mirati, in particolare, alla diminuzione della superficie arata e del periodo durante il quale molti campi rimangono privi di vegetazione, in particolare nel tardo autunno e in inverno.

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Demografia e sopravvivenza della lepre comune (*Lepus europaeus* P.) in un'area della Pianura Padana nord-occidentale

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Questa ricerca, tramite il monitoraggio con censimenti notturni e la radio-telemetria di una popolazione di lepre presente in una zona protetta della provincia di Piacenza (Zona di Ripopolamento e Cattura, ZRC di Borgonovo V.T.), in assenza di disturbo dovuto all'attività venatoria, si propone di individuare gli elementi legati all'habitat, che possono influire sulla dinamica di popolazione della specie. Nello studio è stata stimata col metodo Kaplan-Mayer la sopravvivenza di 29 individui di lepre seguiti con la radio-telemetria, nell'arco di un anno, a partire da gennaio 2015, mettendoli in relazione con i cambiamenti dell'uso del suolo e con l'uso di fitofarmaci utilizzati sulle colture presenti nell'area. In questo modo si è cercato di comprendere come una popolazione di lepre possa reagire e adattarsi ai cambiamenti di paesaggio dovuti alla meccanizzazione e all'intensificazione dell'agricoltura.

Dalla primavera 2013 sono stati svolti censimenti notturni con fari alogeni per determinare le densità pre e postriproduttive dell'area. In questo modo è stato possibile determinare gli incrementi riproduttivi e le mortalità invernali per i diversi anni, è stato, quindi, analizzato l'andamento della popolazione dell'intera ZRC dal 2013 al 2015.

Alla fine del periodo di monitoraggio delle lepri radio marcate, sono rimasti vivi 14 individui su 29 catturati. La sopravvivenza di questi animali è stata messa in relazione con diverse variabili quali l'home-range del singolo individuo, i tipi di habitat presenti in esso, i suoi spostamenti registrati tramite l'individuazione dei siti di riposo diurno e le radiolocalizzazioni durante il periodo di attività, il sesso, l'età e il peso dell'animale, tramite la *Regressione di Cox*. Nessuna delle variabili inserite nell'analisi ha avuto effetti significativi sulla sopravvivenza degli animali.

Dividendo il periodo di monitoraggio in sottoperiodi di 15 giorni, sono state registrate le proporzioni di individui rinvenuti morti in ogni singolo sottoperiodo. In questo modo sono stati individuati due picchi di mortalità relativi ai sottoperiodi che vanno dal 10/04 al 25/04 e dal 25/05 al 09/06. Si suppone ci sia un aumento della mortalità legato ai fitofarmaci utilizzati in agricoltura per i trattamenti in post-emergenza del frumento e per la preparazione dei campi e la semina delle colture estive, come mais e pomodoro.

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Recent increase of wolf predation on dogs in the northern Apennines, Italy

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In Italy, wolf attacks on dogs represent a relatively new and little studied phenomenon. Whereas wolf depredation on livestock is a well known driver of economic conflict, depredation on dogs may likely exert a stronger social impact. In the northern Apennines, this phenomenon increased both in frequency and distribution during the last 4–5 years, with different dog types involved in alleged wolf attacks. Until now, however, data on wolf attacks on dogs have not been systematically collected, nor alleged attacks thoroughly assessed. In order to obtain more reliable information, we: (i) compiled reports of wolf attacks on dogs occurred in the Province of Reggio Emilia and Parma in the years 2011–2016, and (ii) initiated a telemetry study involving 2 wolf packs of known dog-depredation history. We critically assessed each reported attack based on the available information, and regarded as likely wolf attacks those supported by strong evidence, as indicated by veterinary necropsies, type of injuries, patterns of consumption and description of the site of the attack. For likely wolf attacks we also annotated: the dog's breed, sex and age; activity of the dog at the inset of the attack; the alleged predator; the level of consumption on the carcass. To further investigate wolf predation on dogs we live-captured and fitted with GPS collars (Vectronic Pro Light-1) 2 wolves (one adult female and one yearling female) in the Albareto pack (Province of Parma), and a yearling male of the Saccaggio pack (Province of Reggio Emilia), as in both these wolf packs' territories several attacks on dogs had been recently recorded. We configured GPS collars to acquire 1 location/2–4 hrs, shifting to 1 location/5 min when a proximity sensor is activated by UHF tags applied on dogs used by local hunters. Our main aim has been to compare the dogs' locations (as reported by hunters) with those of the collared wolves, and subsequently conduct field surveys to confirm dog depredations.

Overall, out of 60 alleged incidents involving dogs, we regarded 30 as likely wolf attacks, occurring from 2013 to 2015 in an area of about 2500 km^2. Thirteen of the attacks involved hounds and occurred during wild boar hunting drives and hare hunts, peaking in October. The other attacks involved pet dogs, killed during the night at 94$\pm$75 (SD) m from their homes (in 85% of cases at $\leqslant$250 m from a cowshed). The majority of depredated dogs (n=17) were medium-sized, and many of them were only partially consumed, whereas the others 12 involved dogs of small size. About 53% of the attacks occurred in the 2 GPS-studied wolf packs, where we tallied 11 attacks in the Albareto pack, and 5 in the Saccaggio pack.

To our knowledge, wolf predation on dogs has never been reported to this extent, both in the Northern Apennines and elsewhere in Italy. Compared to previous years, the more popular use of GPS collars by hunters could likely determine a higher retrieval rate of dead or injured dogs, thereby increasing the probability that a wolf attack is reported. However, our compilation suggests that the rate of wolf predation on dogs is indeed increasing in our study area. We speculate that several factors can contribute to determine this trend: (i) a higher wolf density, corresponding to increased intraspecific competition both for food and space, forcing some wolves/packs to explore and adapt to new resources; (ii) the individual adaptation by some wolves/packs to prey on hunting dogs due to local conditions, with the subsequent fixation and cultural transmission of this behavioral trait both within and among packs; (iii) the recent and ongoing expansion of wolves in areas characterized by higher density of human settlements and hence availability of working or pet dogs as potential prey. In addition, due to a significant proportion of introgressed individuals in our wolf population, we cannot exclude that wolf predation on dogs in our study area could be facilitated by behavioral novelties due to the introgression of domestic variants into the wolf population. The cases we hereby illustrate represent a local phenomenon not yet widespread at the regional or national scale, even though isolated reports of wolf depredation on dogs are being reported elsewhere in the Northern Apennines (e.g., Piacenza, Modena, Bologna, Pistoia and Pisa Provinces). As it may seriously affect social attitudes and beliefs toward wolf conservation in the future, wolf depredation on dogs should be more thoroughly studied and monitored. Particular attention should be devoted to understand the predisposing factors that, more than others, prompt the development of wolf predatory behavior on dogs, and concur to its maintenance and diffusion at larger scales.

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Motorway or trail? Hunting as a pathway of introduction of alien mammals and birds

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Hunting is generally considered one of the most common motivations for the introduction of mammals (in particular Artiodactyla and Lagomorpha) and birds (in particular Galliformes and Anseriformes). To create new hunting opportunities, for meat or recreation, humans have introduced alien species as quarry for centuries. For instance, wild rabbit since the Middle Ages; fallow deer *Dama dama* since 11th century and common pheasants since 15th century were introduced as game species in many parts of Europe. Several alien species still have great importance as game, for example in France 13.5 million of wild rabbits *Oryctolagus cuniculus* were shot in 1975 and 3.2 million in 1999 and in UK annual common pheasant *Phasianus colchicus* bag was estimated at 12 million. Several game species have been shown to cause a range of negative consequences on indigenous species and ecosystems (e.g. competition, predation, disease and parasite transmission, genetic pollution, habitat alteration, diffusion of alien species) as well as impact to agriculture and forestry.

We performed an analysis based on data from DAISIE European Invasive Alien Species Gateway to evaluate trends of introductions of mammals and birds since 1500, with a focus on the introduction events occurred since 1900. Hunting has always been a fundamental pathway for deliberated introduction of alien mammals and birds with an evident increase in the second part of 19th century. The number of intentional introductions of alien species due to hunting purposes is decreasing since the '80s and resulted to be very low during the last decades. Introduction events for hunting purposes in Europe decreased in the last century from 30% (1900–1920) to 10% (1980–2010) of the total number of known introductions.

Our analysis pointed out a significant change of this pathway in the last decades, and nowadays the intentional introduction of new alien game species is much more uncommon. Several reasons explain this decreased importance: increased awareness of hunters on the problem of biological invasions, changes of national and international regulations, achievement of more sustainable hunting management principles, increase of natural populations of game species. Despite of this decreasing trends, new illegal introductions of alien game species are still reported in different countries (e.g cotton-tail rabbit *Sylvilagus floridanus* in Italy or wild boar *Sus scrofa* in Ireland). Moreover, in addition to the intentional releases of alien species for hunting purposes, it should also be considered the unintentional introductions (escapes) of species used in animal-aided hunting (e.g. falconry, ferreting).

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An empirical test of the functionality of red squirrel (*Tamiasciurus hudsonicus*) rattles

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North American red squirrels (*Tamiasciurus hudsonicus*) are territorial tree squirrels that defend individual territories year round through aggressive vocalizations (rattles) and occasional chasing of intruders. The core of these exclusive territories is a larder hoard of coniferous cones called a midden.

Territory defense is considered to be the primary function of red squirrel rattles. Rattles are assumed to operate by effectively deterring intruders, thus reducing energy costs and the risk of injury associated with direct aggressive interactions. However, to our knowledge, this hypothesis has not been directly tested in red squirrels.

We used a speaker replacement experiment to test the hypothesis that red squirrel rattles function to deter intruders. Between August and September 2015 we removed 29 male squirrels from their territories. Each squirrel was removed from his territory twice, once as a treatment and once as a control (order of treatment and control was randomly assigned) and each removal lasted 120 minutes or until an intruder arrived, which ever came first. When removed as a treatment, a loudspeaker was placed at the center of the squirrel's midden and broadcast that individual's rattle at 7-minute intervals for the duration of the removal. When removed as a control, the squirrel's territory was left silent (no speaker replacement). During each removal an observer monitored the midden from no less than 5 m away and collected information about the identity of any intruders and their behavior.

We found that there were significantly fewer intruders during removals with a speaker replacement, suggesting support for the hypothesis that territorial rattles function as a deterrent against intruders. However, intrusions were not entirely prevented by the speaker replacement, which indicates that rattles alone may not be 100% effective without a visual cue of the midden owner.

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Catch me if you can: a new method to live trap semi-fossorial voles

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The typology of trap, as well as its size and the used bait, has a considerable influence on the capture success of small mammals. By contrast, the tendency of rodents and shrews to walk close to stones or woods (thigmotaxis) may represent a limit for capturing species living in open habitats, e.g. meadows and prairies, as the semi-fossorial voles *Microtus* spp. This could be particularly true in alpine prairies where the densities of the species is likely low. During a project on the distribution of small mammals on an elevation gradient carried on at the Gran Paradiso National Park, we developed a technique to increase the capture success of these rodents in altitude prairies. Three species of semi-fossorial voles are recorded within the National Park: *Microtus arvalis*, *Microtus savii* and *Microtus multiplex*. In previous studies, we verified that live-traps simply placed at the tunnel entrances of the burrow systems were ineffective to trap *Microtus* voles. Therefore, we applied a box in Tetrapak™ with the perforated floor at the opening of Sherman traps (large size: 229×89×76 mm, and small size: 165×64×52 mm). In this way, the vole, leaving the den dug on the ground, would remain in a confined status, in the dark in the Tetrapak™, and is therefore forced to enter the trap or go back in the hole. A stone was applied over the trap to prevent voles overthrow it and escape. To increase the success rate, active burrows were evaluated by relying on the vole's propensity to re-open tunnel entrances previously closed with soil. Accesses to holes were identified and covered to verify which of them were actually re-opened after 48 hours. Sherman traps modified with Tetrapak™ were positioned immediately upon the holes re-opened after 48 hours, alternating with the same number of unmodified Sherman traps. Controls were carried out three times a day to reduce the mortality of individuals caught in the traps. Two trapping sessions of *Microtus* voles were carried out, for three days each, at eight sites within the National Park between June and October 2015, with a total of 58 modified and unmodified traps per session. Overall, 55 *Microtus* voles has been trapped: 41 (74.55%) voles were caught in traps modified with Tetrapak™, the other 14 (25.45%) in unmodified traps (χ^2=13.25, p<0.001). Interestingly, 6 individuals were caught in unmodified traps placed within marmot burrows. Therefore, the Sherman live-traps modified with Tetrapak™ here described represent a successful method to increase the capture success of semi-fossorial voles.

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Altitudinal distribution range of small mammals at Gran Paradiso National Park

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Given their high adaptive radiation, terrestrial small mammals (Rodents and Soricomorphs) are widely distributed throughout the world, often with high species richness; therefore, they represent a model group for studies of overlapping range distribution along elevational gradients. In this study, we evaluated the richness and diversity of species of terrestrial small mammals along altitudinal gradients in the Gran Paradiso National Park. Different models of traps (large Sherman, small Sherman, Ugglan and Longworth) were used to promote adequate sampling of all the species. Seven altitudinal levels, separated from each other 300 m, between 800 and 2600 m, were identified in three valleys within the park (Valle Orco, Vallone del Piantonetto and Valsavarenche): a transect of traps was set on each of them. Transects were replicated in two sessions, the first between May and July, the second between July and September. A total of 135 traps for the first session and 146 for the second were used. Captured animals were marked through hair cutting, to recognize individuals previously captured and measured within the same trapping session. We captured a total of 971 animals (888 Rodents and 83 Soricomorphs) with 1160 events capture, for at least seven species of Soricomorphs and 10 species of Rodents. Wild mice *Apodemus* spp. are presently determined only at the genus level, waiting for the results of genetic analyses. The maximum number of taxa was recorded at intermediate altitudes (1400–1700 m), where mainly lowland species reach the maximum altitude and subalpine and alpine species the lower. Five taxa were trapped in deciduous woodlands (800 m): *Glis glis*, *Myodes glareolus*, *Apodemus* spp., *Sorex antinorii* and *Crocidura suaveolens*. Seven taxa were trapped in mixed deciduous and coniferous woodlands (1100–1400): *G. glis*, *Eliomys quercinus*, *M. glareolus*, *Chionomys nivalis*, *Apodemus* spp., *Microtus multiplex* and *Sorex antinorii*. The same number of taxa were trapped in coniferous woodlands (1400–2000 m): *G. glis*, *E. quercinus*, *M. glareolus*, *C. nivalis*, *Apodemus* spp., *M. multiplex*, *Microtus arvalis* and *S. antinorii*. In alder woodlands (*Alnus viridis*) along the rivers (2000 m), six taxa were trapped: *E. quercinus*, *M. glareolus*, *C. nivalis*, *Apodemus* spp., *M. multiplex* and *S. antinorii*. Six species were recorded in alpine prairies and screes (2300–2600 m): *C. nivalis*, *Microtus savii*, *M. multiplex*, *M. arvalis*, *Sorex alpinus* and *S. antinorii*. Some species were trapped with only one individual throughout the three valleys and the two trapping sessions and were not counted in the previous analysis: *Talpa europaea* (800 m), *Talpa caeca* (1100 m), *Neomys fodiens* (1400 m), *Sorex minutus* (2000 m), *Mus musculus* (800 m) and *Muscardinus avellanarius* (2000 m). The only species trapped at all the elevation levels and in all the habitat types was *Sorex antinorii*. Among glirids, *E. quercinus* was only trapped in coniferous forests, while *G. glis* was more common in deciduous ones and only an occasional visitor in coniferous forests. Voles belonging to the genus *Microtus* are typical of prairies and open habitats, while *C. nivalis* was found always in association with rocky habitats and *M. glareolus* both in deciduous and coniferous woodlands. Among shrews, *C. suaveolens* has been only captured in moist deciduous woodland at low altitudes, while *S. antinorii* is ubiquitous and it was captured in all the investigated habitat types.

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Ectoparasites of the European red squirrel from the Apennine ridge

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The European red squirrel *Sciurus vulgaris* is a common arboreal rodent in Tuscany. Main threat to this species are represented by habitat fragmentation and loss, i.e. wood cutting, and competition with the introduced grey squirrels *Sciurus carolinensis*. This competition may occur in different forms including competition for food resources, transmission of disease and parasite-mediated competition. While the first two different impacts by this species has been widely analyzed, the magnitude of the last one has been only evaluated in Northern Italy. The parasite fauna of *S. vulgaris* from Central and Southern Italy is almost completely unknown. Moreover, during the last decades, an expanding population of the invasive *S. carolinensis* from Umbria and first records from Tuscany have been reported, thus emphasizing the importance to fill the gap of this knowledge.
In this work, a total of 34 road-killed individuals of *S. vulgaris* along the Apennine ridge (Tuscany, provinces of Siena, Florence and Grosseto) were checked for ectoparasites (fleas and hard ticks) during 2011–2015. Two individuals preyed upon by domestic cats were also checked. Overall, 24 squirrels (66.67%) were infested by three species of flea (*Ceratophyllus sciurorum*, *Myoxopsylla laverani* and *Pulex irritans*) and two species of hard tick (*Ixodes ricinus* and *Pholeoixodes hexagonus*). Parasites were collected and stored in absolute ethanol. Species identification was based on the morpho-anatomical examination and referred to published descriptions for Ixodidae and Siphonaptera. Abundance of ectoparasites was higher in areas with a higher fragmentation level, which includes large roads and areas with a greater habitat diversity, respect to the densely wooded areas. The most frequent species was the squirrel flea *Ceratophyllus sciurorum* (22.2%), with a peak in late summer and early autumn. The second most abundant species was *Ixodes ricinus* (prevalence: 13.89%), a generalist hard tick commonly found in rodents. The remaining species of hard ticks (*P. hexagonus*) and of both fleas (*P. irritans* and *M. laverani*) had a prevalence of 8.33% and 11.11% respectively. Even if road-killed individuals rapidly lose their ectoparasite fauna, this work represents the first attempt of assessing the arthropod fauna parasitizing native squirrels along the Apennine ridge. This amount of knowledge should be implemented since the populations of introduced grey squirrels are expanding in Central Italy and parasite-mediated competition with the native species may occur.

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Monitoring and conservation of mammals in the Sirente Velino N2000 sites

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As part of the implementation of the Measure 3.2.3. ("Tutela e riqualificazione del patrimonio rurale") concerning conservation and development of the rural patrimony of the Rural Development Plan 2007–2013 of the Abruzzo Region were elaborated management plans for Nature 2000 sites present in the region, in accordance with art. 4 of D.P:R. 357/97 and subsequent amendments. The Sirente Velino Natural Regional Park, established by Regional Law 54/1989 and currently extended ca 54,000 ha is Managing Institute of Sites N2000 extended for about 67,815.00 ha, all in the Province of L'Aquila. In particular Natura 2000 sites involving the Park and objectives of studies are: ZPS IT7110130 Sirente Velino (59,134 ha); SIC IT7110206 Monte Sirente Monte Velino (26,654 ha); SIC IT7110075 Serra and Gole di Celano - Val D'Arano (2,350 ha); SIC IT7110090 Colle Rascito (1,037 ha). The knowledge framework on mammals about involved Sites N2000 includes data resulting from: an analysis of the data reported in the N2000 standard data forms for the species listed in Annex I and Annex IV of Dir. 92/43 EEC; an analysis of the available literature concerning the sites and the species considered; a survey of past data from previous surveys conducted in the study area; specific monitoring studies through field surveys. A total of 21 species of mammals, listed in the Dir 92/43 EEC, are present in the N2000 involved, whereas a total of n=4 species are listed in the standard data forms of N2000 sites (updated October 2013). Upgrading related to the elaboration of the management plans has led to an increase of more than 80% of the total number of previous species present in N2000 sites. The main findings related to the presence and distribution of species listed in the Dir 92/43 EEC and the identification of the most significant biotopes for species in the N2000 Sites have discussed. The increase of knowledge is a prerequisite to adequate protection activities and the implementation of suitable conservation measures and highlights the need for continuous monitoring actions.

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Reintroduction of Apennine chamois in Sirente Velino Regional Park: current status

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Apennine chamois (*Rupicapra pyrenaica ornata*), an endemic subspecies of the central Apennines, identified in Annex II of the Habitats Directive as a species of conservation priority, survives today in only four populations present on the main massifs of the central Apennines.
According to that identified in the National Action Plan for the species, establishing as a conservation goal the presence of a fifth population in the massifs of Sirente and Velino, the reintroduction in the Regional Park Sirente Velino was started, in close collaboration with other parks, within the project LIFE+ COORNATA (LIFE09 NAT/IT/00183); the project had as coordinating beneficiary the National Park Majella and as associated beneficiaries, in addition to our park, the NP Abruzzo, Lazio and Molise, the NP Gran Sasso and Monti della Laga, the NP Monti Sibillini and Legambiente.
Following preliminary actions (update of the feasibility study, establishment of a specific protection area for the Apennine chamois) between July and October 2013 it was released a first chamois founders nucleus from catches in nature and wildlife enclosure areas.
All individuals released were marked by ear tags and fitted with GPS/VHF radiocollars (Vectronic, Followit). The monitoring of movements of individuals was carried out both using GPS locations, VHF fixes and by direct observations. Further data are derived from the first autumnal census conducted by standard methods.
At present 19 chamois have been released whereas a minimum number of 10 kids were born in the new area. Total locations (n=29749 fixes until January 31, 2016) describe the outcome of releases and overall spatial distribution of the chamois present until today in the territory. The implementation of specific conservation measures carried out in the new area of presence continue as established in the after-life Apennine chamois Conservation Plan. This contribution provides an update on the reintroduction program still in progress.

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Predation of nests of alien pond sliders (*Trachemys scripta*) by red foxes (*Vulpes vulpes*)

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One of the main factors countering the spread of alien organisms is biotic resistance, including predation by native species. However, neophobia (the innate tendency to avoid unknown food items such as newly introduced potential prey) may make the latter difficult to take place. Neophobia is likely less pronounced in ecologically flexible mesocarnivores which may thus be good candidates as predators of exotic organisms. In this study we show for the first time that red fox (*Vulpes vulpes*) may prey on nests of the alien pond slider *Trachemys scripta*. The latter is native to Central and South America, but is now widespread in many countries, including Italy, after being imported as a pet and deliberately released to the wild. We did our study in the WWF Astroni Nature Reserve (Naples, S Italy). During the oviposition period (April-July) we detected seven nests and protected one with a mesh fence to establish the time of hatching. The latter nest was examined after 114 days after fencing and eggs were found not to contain embryos. All other nests were destroyed, and eggs removed, by carnivore predators which typically marked with scats the sites they had burrowed. The identification of scats as well as images obtained with a camera-trap showed that red foxes occurred in the area and most likely fed on eggs. To establish which environmental cues lead foxes to detect nests we carried out three predation tests by setting up fake pond slider nests baited with quail eggs. One test was aimed to determine whether *T. scripta* smell helps the predator to detect eggs underground; in a second test, we looked at the actual effect of egg presence, whereas in the last we tested whether the traces left on the ground by pond sliders when digging or burying eggs (displacement of soil or litter) were located by red foxes. Fake nests were placed at different distances from vegetation edges to see whether edge effect influences predation rates. We found that nests closer to vegetation edges are more exposed to predation and that the main cue driving nest detection by red foxes is the pond slider's smell. At wetland sites occupied by the pond slider we propose that vegetation be cleared in specific, well-exposed spots close to vegetation edges in order to encourage pond sliders to nest there and thus favour fox predation or manual control by egg removal.

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Ecological factors affecting Alpine chamois population recruitment: remote sensing can support adaptive management

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The analysis of ecological factors able to affect the life history traits of ungulates is important to reveal key information on population dynamics of wild herbivores. As regard to bovids, it is often crucial for juveniles and yearlings to gain quickly body size and mass, as such growths primarily increase chance to reach reproductive maturity (i.e., an increase in the survival probability). Accordingly, we modeled a set of ecological factors accounting for the variation of Alpine chamois (*Rupicapra rupicapra*) population recruitment through three indexes: i) the ratio kids/adult females (NK/NF), ii) the ratio yearlings/adult females (NY/NF), and iii) the yearlings eviscerated body mass (YBM). These indexes were derived respectively from block count census and from hunting records in the last 45 years in different ecological contexts in the South-West Trento province. These indexes were associated to forage quality/quantity, winter harshness, and local chamois density. In detail, we considered NDVI (Normalized Difference Vegetation Index) as a proxy for the quality of Alpine meadows used by chamois in spring and summer and snow cover data belonging to the National Aeronautics and Space Administration (NASA) remote sensing dataset (TERRA-MODIS). The reproductive success of these populations was strongly influenced both by the quality of meadows during births period (May) and by the space-time pattern of growth and maturation of Alpine pastures in spring and summer periods. Even winter harshness played an important role in this process. In particular, i) the NK/NF was positively influenced by the average quality of the grazing season previous to the births period and by the maximum NDVI value recorded in May (i.e., births period); ii) the NY/NF was negatively affected by the extent of snow cover in the first winter of kids and positively related to the average quality of the pasture in the subsequent spring and summer (i.e., the feed intake period in which individuals had to recover weight loss derived from previous winter); and iii) the YBM revealed a negative trend during the study period suggesting a difficult adaptation to climate and environmental changes taking place. Contrary to our expectations, local density was not able to influence these variables. This result may suggest that local density are not exceedingly high in the study area and therefore are not able to promote density dependent phenomena. In conclusion, these results contribute to increase the knowledge of the mechanisms underlying Alpine chamois population dynamics and give insights to plan adaptive management and conservation of this species.

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Many Italian Mammals are likely to be at risk from water pollution

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The use of pollutants from agriculture and industry has increased steeply over the last 50 years, causing serious environmental consequences. Water pollution is caused by the introduction of contaminants to a system, and it can be determined by the addition of organic and inorganic material, floating matter, pathogens and increases in water temperature. Chemical runoff from farms and industries is leaching into nearby rivers, streams and groundwater, killing thousands of animals. Many species of mammals use aquatic habitats for foraging and for drinking water. These species often play a fundamental ecological role and can be considered as environmental indicators. In this study I analysed the relationships between the distribution of mammal species in Italy known to be sensitive to water pollution from the literature, and the distribution of both legal and illegal dumps, agricultural areas, industries and the pollutants they release. In this way, I found that most of the species considered in the study can suffer from water pollution in at least part of their range. This is mainly due to the fact that they live in proximity to sources of pollution, and this is likely to influence their presence in the most at risk sites. In order to avoid losing mammals that play a key role in the ecosystems, we should pay particular attention to emissions in sites that host large number of sensitive species.

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Dati sulla presenza del lupo nella Riserva Naturale Monte Rufeno (Acquapendente, Viterbo, Italia)

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La presenza storica del lupo (*Canis lupus*) nel territorio della Riserva Naturale Monte Rufeno non è supportata da dati certi, sebbene esistano numerose indicazioni e toponimi che dimostrerebbero passaggi sporadici di individui isolati, segnalati tuttavia soltanto a partire dagli anni '90. Il frequente rinvenimento in questi ultimi anni di tracce ed escrementi riconducibili alla presenza della specie fa rientrare la Riserva fra i territori di nuova colonizzazione, in coerenza con un generale ampliamento dell'areale del lupo evidenziato di recente in tutta la penisola italiana.

A partire dal 2010 sono state avviate alcune attività di indagine più approfondite, cioè l'effettuazione di sessioni di *wolf-howling* nel periodo estivo, la ricerca attiva di escrementi e tracce, anche su neve quando possibile, e la collocazione opportunistica di trappole fotografiche lungo percorsi ritenuti idonei agli spostamenti della specie. I dati raccolti fino al 2015 confermano la presenza di un nucleo riproduttivo stabile all'interno del comprensorio Riserva Monte Rufeno (Lazio) -– Selva di Meana (Umbria).

In particolare, sono state programmate sessioni di *wolf-howling* durante il mese di agosto o nella prima metà del mese di settembre per sei anni consecutivi (2010–2015), individuando 6 stazioni fisse in corrispondenza delle quali sono state effettuate due triangolazioni. La scelta di questi punti è stata condizionata dalla particolare morfologia del territorio e dalle conoscenze pregresse sulla probabile presenza della specie; non è stato quindi previsto un campionamento di tipo sistematico, avendo come obiettivo primario solo quello di accertare l'effettiva presenza della specie e non una stima della popolazione. Per ciascun anno di attività è stata ottenuta la risposta di un branco costituito sia da individui adulti che giovani proveniente da una sola area, la cui definizione è avvenuta appunto mediante triangolazione.

Il *rendez vous* è stato localizzato di anno in anno in aree diverse lungo una fascia di territorio al confine con la vicina Selva di Meana (Umbria).

Una volta verificata la presenza stabile di un branco, sono state collocate dalle 2 alle 5 trappole fotografiche, anche questa volta in modo opportunistico, con l'obiettivo di confermare il regolare passaggio degli animali e definirne gli spostamenti. Dopo circa 28 giorni dal posizionamento delle fototrappole sono state ottenute le prime immagini che hanno confermato la presenza di un gruppo familiare. A quel punto sono stati scelti alcuni passaggi abituali in ciascuno dei quali è stata collocata una fototrappola fissa per tutto l'anno. Il controllo delle immagini, svolto a cadenza almeno mensile ogni anno dal mese di settembre 2010, ha permesso di evidenziare gli spostamenti degli individui all'interno dell'area protetta e di individuare le zone maggiormente frequentate. Sono stati raccolti una media di 8 foto o filmati utili al mese, da cui è stato possibile stimare una dimensione media del branco negli anni pari a 6 individui.

A partire dal 2011 è stato avviato un percorso di collaborazione con i tecnici della Regione Umbria per la raccolta dati e il monitoraggio del branco presente sul territorio a cavallo tra le due Regioni. In particolare, grazie a questo accordo, è stato possibile sottoporre ad analisi genetica alcuni campioni biologici raccolti nel territorio della Riserva Monte Rufeno.

Nella logica che i territori occupati dal lupo siano ben più ampi dei limiti amministrativi dell'area protetta, dal 2015 è stato avviato un programma di ricerca che comprende: la raccolta sistematica di dati basata sull'uso combinato di transetti e fototrappole sia all'interno dell'area protetta che nelle zone limitrofe, interviste agli allevatori delle principali aziende presenti nel comprensorio oggetto di indagine, interviste agli Enti di competenza nella gestione della fauna selvatica, con l'obiettivo di correlare la presenza del lupo con l'incidenza dei danni agli allevamenti e per realizzare una carta di distribuzione del rischio. Una parte dei dati raccolti sarà oggetto di una tesi di laurea triennale.

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Investigating microhabitat structure and spatial niche overlap of two sympatric dormouse species. A case study in a central Apennine forest

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Small mammals in general, and rodents in particular, are important functional components of ecosystems. The ecological distribution and the relative abundance of small mammals play a key role in many ecosystems, including European temperate forests. We designed a study to investigate and characterize environmental niche of two strictly forest-dependent arboreal rodents: the hazel dormouse *Muscardinus avellanarius* and the edible dormouse *Glis glis*. The study is co-funded by the LIFE09 ENV/IT/000078 ManForCBD project aiming at finding forestry best practices for biodiversity conservation, and the improvement of ecosystems' connectivity within a multiple-use forest context. The research project was carried out in central Italy across the Provinces of Aquila and Isernia (41°43' N - 14°6' E, elevation 650–1300 m a.s.l.) and is characterized by coppices and high forests of Beech (*Fagus sylvatica*) and Turkey oak (*Quercus cerris*) stands.

One hair-tube and one nest-box were set at 93 sites at minimum distance of 200 m to avoid spatial correlation. Sites were checked for two years (2012 and 2013) every 15 days from August to October, covering the activity period of target species in these mountain habitats. Indirect signs found on nest-boxes and hair-tubes were used to identify the target species. Droppings, teeth marks on hazelnuts and nest types were identified by means of field guides; hair samples were taken to the laboratory for subsequent species determination based on the hair cuticle pattern.

A set of 39, qualitative and quantitative, dendro-auxometric and structural characteristics of forest stands were measured within a circle of 13 m radius surrounding each sampling site to typify habitat qualities.

Variables were checked for multicollinearity and a final subset of 15 predictors with a correlation $\leqslant 0.7$ were retained using `polycor` package in R. To characterize the environmental niche of the two species and quantify their niche overlap, the whole set of 93 sites and 15 variables were entered a multivariate analysis for mixed data (FAMD) available in `FactoMineR` R package. Starting from the scores on the first two FAMD axes, the two species niches were quantified by applying a kernel smoother and the niche overlap was calculated with the Schoener's D, also testing for significant niche similarity using the `ecospat` R package.

In a subsequent step, the subset of five quantitative variables were entered a separate exploratory multivariate ordination analysis (PCA). Finally, species co–occurrence was also tested by using the `co-occur` package in R.

The hazel dormouse was the most frequent species (52 sites, 55.9%), while the edible dormouse was found in 35 of the 93 sites (37.6%). A significant niche similarity was revealed by the niche overlap analysis performed on the scores of the first two FAMD axes. Despite the significant similarity, a difference in amount of overlap and niche breadth is clearly evident between the two species. The spatial niche of *Glis glis* is totally included in that of *Muscardinus avellanarius*, this latter being also characterized by two distinct cores and an extended exclusive intervals. The biplot of the first two PC scores of quantitative variables (40.6% and 23.4% of cumulative variance) indicate that *Muscardinus avellanarius* preferred uneven-aged forest stands (mean values and standard deviations of stem diameter) and negatively influenced by stand density (number of plants/ha). For *Glis glis* there was not any clear relationship with either presence or absence for any of the five quantitative forest variables selected. Interestingly, the co-occurrence test was not significant, suggesting that competitive exclusion may act as a response to niche overlap and interspecific competition between the two species.

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The bats of Gran Paradiso National Park: inventory and preliminary characterization of distribution, with evidence of the influence of artificial lighting

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The distribution and ecology of bats in the Italian Alps are still poorly known. This was also true for Gran Paradiso National Park, the largest protected area of the Western Italian Alps. In order to inventory the bat species of the area and to begin to characterize their distribution, summer surveys were carried out from 2011 to 2015. Data were collected through mist-netting, acoustic recording and inspection of potential roost sites.

Mist-netting over 11 water basins, located mainly in the valley bottoms, led to the capture of 103 individuals of 8 different species, among which *P. pipistrellus* was the most abundant and frequently caught. A further 84 individuals, belonging to 4 species, with a strong prevalence of *P. macrobullaris*, were mist-netted at 3 sites on Alpine pastures and prairies.

Acoustic surveys were performed along valley bottoms, beneath the current forest limits, according to a standardized protocol involving samplings in early and late summer. Twenty sampling points were established in ecotones (wood edges, clearings, forest trails), in natural darkness, and 20 additional points in nearby sites, closer to buildings and in the presence of artificial light sources (mercury and high pressure sodium lamps). At least 13 species were recorded; bat passes were mainly due to *P. pipistrellus*, with *Myotis* spp. and *H. savii* following far behind. *B. barbastellus*, *Myotis* spp. and *Plecotus* spp. occurred more frequently at unlit and more natural sites.

Further acoustic surveys were performed at sites located far from artificial light sources, at current forest limits or above: 13 sampling points were established between 1800 and 2200 m a.s.l., in areas where open spaces dominated by herbaceous species represent a consequence of timber cutting and pasture use ("alpine 1" habitat type), and 5 at sites between 2200 and 2600 m, located above the natural tree line and characterized by mosaics of herbaceous vegetation and rocks ("alpine 2" habitat type).

As a general trend, bat activity decreased with elevation and when moving to zones with a simpler vegetation structure, but profound differences, both in terms of activity and species occurrence, were observed on a local basis.

Two "alpine 1" areas of a same valley, with similar elevation but different ecological conditions (presence/absence of lentic water basins, distance from woods, exposition, zootechnical use) were surveyed more in depths. About 115 hours of acoustic sampling were performed for each area, according to a standardized protocol. In one area bat activity resulted by far dominated by *P. pipistrellus*, with genus *Myotis* and *E. nilssonii* following far behind; in the other area co-dominance of *H. savii* and *P. pipistrellus* was observed, while the next most recorded acoustic category was the group of species *Eptesicus serotinus/Vespertilio murinus/Nyctalus leisleri/Nyctalus noctula*, among which only *N. leisleri* of ascertained occurrence. Factors possibly explaining differences in the local activity of these and the other recorded taxa are suggested.

Six additional sites, situated along a route from 1845 m ("alpine 1") to 2460 m ("alpine 2") a.s.l., including a point with artificial lighting (a dike lighted with metal halide lamps) were surveyed monthly from June to September. In spite of its high elevation (2292 m) and the characterization of surrounding environment as "alpine 2", under favorable weather conditions the lighted point showed much higher bat activity than that recorded at the other 5 sites, and this was of two orders of magnitude greater than in every unlighted "alpine 2" site surveyed in the Park. Acoustic detection and mist-netting demonstrated the presence at the site of all the species recorded in the "alpine 2" habitat type as well as of other species, notably *B. barbastellus*, possibly driven to the site by the swarms of migrating moths attracted by the light. On the other hand, activity values suggest that bat species react differently to the foraging opportunities provided by the lighted site, showing different levels of attraction or, in the case of *Myotis* spp., no attraction at all. Lighting therefore shows the potential to alter bat communities . Because of the scarcity of underground sites in the Park, only few results were obtained by inspecting potential roost sites. 16 roost (mainly in buildings) were identified; they were used by at least 5 species, among which *P. macrobullaris* prevailed.

The presence of at least 16 bat species was ascertained in the Park. All of them occur between the lower borders of the area (about 800 m) and higher elevations and for 12 species national altitudinal records were recorded (in brackets): *M. daubentonii* (1665 m), *M. mystacinus* (ascertained at 2292 m, but records of *Myotis* sp., probably due to the same species, were collected at 2460 m), *Myotis myotis* vel *blythii* (2460 m), *Myotis nattereri* complex, *P. kuhlii* (ascertained at 1850 m; echolocation calls attributed to *P. kuhlii* vel *nathusii* were recorded at 2292 m), *P. pipistrellus* (2460 m), *P. pygmaeus*, *H. savii* (2460 m), *E. nilssonii* (2460 m), *E. serotinus*, *V. murinus* (1845 m), *N. leisleri* (2460 m), *P. auritus*, *P. macrobullaris* (ascertained at 2292 m, but records of *Plecotus* sp., very probably of the same species, were collected at 2500 m), *B. barbastellus* (2292 m) and *T. teniotis* (2560 m).

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Esperienze di rilevamento biometrico a confronto: verso una gestione condivisa del cinghiale

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La caratterizzazione morfometrica di una popolazione, che descrive le proprietà dimensionali in termini di tendenza centrale e variabilità, permette di documentare la variabilità delle dimensioni corporee di un ungulato in funzione del suo habitat. Per il cinghiale ciò è particolarmente interessante dal momento che il suo areale risulta molto esteso e ha una grande capacità di modulare le dimensioni corporee nel processo di adattamento ad ambienti diversi. Le misurazioni biometriche raccolte durante la stagione venatoria direttamente dai cacciatori potrebbero fornire un campione interessante e ripetibile nel tempo, con la possibilità di condurre indagini su serie storiche di dati: si tratterebbe infatti di ottenere dati biometrici di migliaia di esemplari, raccolti su una scala territoriale molto estesa e che può essere effettuata ogni anno. I valori rilevati tuttavia, soprattutto quando si parla di variabili continue, devono rispondere alle caratteristiche di accuratezza e precisione. I fattori che influiscono su tali caratteristiche dipendono principalmente dallo strumento utilizzato e dalla capacità del rilevatore.

L'obiettivo di questo studio è di valutare l'affidabilità delle misurazioni effettuate in campo dai cacciatori, al fine di identificare le variabili con caratteristiche tali da poter essere utilizzate per un monitoraggio biometrico della popolazione di cinghiale e individuare eventuali necessità di formazione dei cacciatori stessi in materia di rilevamento morfometrico.

Durante la stagione venatoria 2015–2016 sono state fornite agli Ambiti Territoriali di Caccia ATC1 e ATC2 della provincia di Perugia (Regione Umbria) 1000 schede per il rilevamento morfometrico, complete di istruzioni per la compilazione, da consegnare alle squadre di cacciatori. È stato chiesto di misurare le seguenti variabili continue: peso pieno (PP), lunghezza totale (LT), circonferenza toracica (CT), circonferenza pelvica (CP), lunghezza piede posteriore (LPP), lunghezza coda (LC), altezza padiglione auricolare (HPA), altezza e larghezza del disco nasale (HDN-LDN). Il campione è stato confrontato con un campione di controllo (N=445) costituito da misurazioni effettuate per mezzo di rilevatori esperti, utilizzando la stessa metodologia di rilevamento. Rispetto alle 1000 schede consegnate, ne sono state restituite 494 (49.4%) di cui il 25.1% sono state invalidate a causa di palesi errori nella compilazione.

Al fine di testare l'affidabilità delle misurazioni sono stati confrontati i due *database* (dati ATC e controllo), suddivisi in quattro classi di età: 0: <12 mesi; 1: 12–24 mesi; 2: 25–36 mesi; 3: >36 mesi. È stata effettuata un'analisi della significatività delle differenze (p<0.01) tra le medie dei diversi *database*: quando la differenza tra le misure non era significativa è stato confrontato anche il coefficiente di variazione, discriminando le variabili per le quali la differenza tra i coefficienti di variazione (ΔCV) era superiore al 5%.

Il confronto tra i *database* delle variabili LC, LPP, LDN e HDN mostra differenze significative o un ΔCV >5% in tutte le classi d'età così come l'HPA a eccezione delle misure relative alla classe 1 (ΔCV <5%). Le variabili LT e CP mostrano differenze significative nelle classi 1 e 3 mentre quelle relative a CS e PP nelle classi 2 e 3. Differenze nei coefficienti di variazione inferiori al 5% si riscontrano nella classe 0 per PP, LT, CS e CP, nella classe 1 per PP, CS e HPA e nella classe 2 per LT e CP che pertanto possono essere considerate le misurazioni maggiormente affidabili. Come atteso, le misurazioni che richiedono un maggiore grado di precisione quali LDN e HDN non sono state effettuate correttamente dai cacciatori così come le misure LPP e LC che, sebbene necessitino di un grado di precisione inferiore, si sono dimostrate non affidabili. Inoltre, all'aumentare dell'età dell'animale diminuisce tendenzialmente l'affidabilità della misurazione.

Per quanto riguarda la variabile peso, nonostante mostri valori di ΔCV <5% nelle classi 0 e 1, è necessario considerare che molte squadre non posseggono un dinamometro e in questi casi il valore stimato è legato all'esperienza del cacciatore che effettua la misura.

Alla luce dei risultati ottenuti, le misure che mostrano un maggiore grado di affidabilità sono la LT e le misure delle circonferenze toracica e pelvica. Nell'ottica di applicare anche ai dati provenienti dall'attività venatoria gli scopi, i principi e le metodologie della *citizen science*, già parzialmente messi in atto dall'Osservatorio Faunistico Regionale della Regione Umbria per la raccolta di dati faunistici, una formazione mirata al miglioramento delle conoscenze morfometriche, all'utilizzo degli strumenti di misurazione e alla necessità di effettuare le stesse con accuratezza e precisione è fortemente auspicabile.

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Interazione tra giovane aquila reale e adulto di camoscio d'Abruzzo

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L'aquila reale *Aquila chrysaetos* rappresenta uno dei principali predatori per il camoscio *Rupicapra* spp., in modo particolare nei confronti dei piccoli dell'anno, che rientrano tra le dimensioni caratteristiche dei mammiferi di media taglia, come lepri, marmotte, volpi, ecc. Non di frequente si verificano anche attacchi ad individui adulti che, se riescono a far precipitare da pareti rocciose, vengono poi consumati come carogne. I camosci adulti sono molto attivi nel difendere i giovani ed il comportamento delle madri che difendono la prole nei confronti dei grandi rapaci è noto per diverse altre specie sia in Europa che in Nord America. Nella tarda mattinata del 17 gennaio 2013 è stato osservato e documentato fotograficamente, l'attacco di una giovane aquila reale ad un adulto di camoscio d'Abruzzo (*Rupicapra ornata*), sul versante orientale del Parco Nazionale della Majella, nel territorio di Lama dei Peligni (CH). La giovane aquila, preceduta dalla coppia di adulti, è in perlustrazione sul ripido e roccioso versante montano, dirigendosi verso il settore più settentrionale e ad una quota di circa 1400 m s.l.m., poco al di sotto del limite della neve. Dopo circa 10 minuti, le aquile tornano indietro sullo stesso percorso e, mentre i genitori proseguono, l'immaturo effettua un primo attacco nei confronti di un camoscio adulto, che viene sorpreso mentre era solo, intento ad alimentarsi su un piccolo pianoro erboso. Il rapace compie complessivamente 4 attacchi nell'arco di circa 3 minuti; al primo non c'è nessuna reazione da parte del mammifero, al secondo solo un atteggiamento di difesa, mentre negli ultimi due è il camoscio ad anticipare l'arrivo dell'aquila, contrattaccando in corsa e compiendo piccoli salti e mostrando le corna. Tutto ciò fa supporre che il giovane rapace stesse esercitandosi per perfezionare la predazione, mentre risulta interessante l'insolito comportamento del camoscio, episodio molto simile a quanto riscontrato di recente da altri autori sul versante meridionale delle Alpi Marittime, da parte del camoscio alpino (*Rupicapra rupicapra*).

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Presence data of four species of Annex IV and V (92/43/EEC) in Natura 2000 sites of the Abruzzo region

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The surveys were conducted between 2013 and 2015 as part of the monitoring aimed at drawing up of certain plans of Natura 2000 Sites Management (Contribution of Measure 323 of the PSR 2007-2013 Abruzzo Region) in southern and interior Abruzzo. In 12 N2000 sites were conducted investigations with the camera trapping technique, complemented with direct observations, which allowed to obtain information about the presence of *Hystrix cristata*, *Martes martes*, *Mustela putorius* and *Felis sylvestris*. These species were not included among the taxa reported in the Standard Data Forms of the examined sites, except *F. sylvestris* for Site "Abetina Rosello e Cascate del Rio Verde". The camera trapping was performed with the use of infrared camera traps fitted with black flash.

The *H. cristata* was detected in 5 of 12 site (41.7%), of which two sites are in Aquila Province where the species was already known in the wide area, while the other three sites are located in the basins of the Sangro - Aventino and Trigno - Sinello, where the species has recently reporting. *M. martes* was detected in one Site to 12 (8.3%), where it was possible to get different daytime images, while identification with nighttime images in black and white, left undetermined identification in 4 Sites. *M. putorius* was detected in 4 out of 12 sites (33.3%), all located in the basin of the Sangro-Aventino and always in areas located near waterways. *F. sylvestris* was detected in 6 of 12 sites (50.0%), all located in the basins of Sangro-Aventino and Trigno-Sinello. The results for *H. cristata* are consistent with the general trend of expansion of the distribution of the species, which in recent years is also affecting the southern Abruzzo (in the area the first observations are of the end of the last century).

The results for *F. sylvestris* have allowed to ascertain a wider frequency than previously known, perhaps because of a high effectiveness of the camera trapping for the monitoring of the species. The use of camera traps infrared black flash, necessary for us to maximize the concealment of the devices, may have reduced the effectiveness of detection on the two species of Mustelidae, because of the lower quality of nocturnal images and restitution in black and white.

The results are still to be considered as preliminary and will hopefully being updated with further monitoring required for N2000 sites.

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The results are still to be considered as preliminary and will hopefully being updated with further monitoring required for N2000 sites.

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Bat monitoring in 19 N2000 sites of the Abruzzo region: first data

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The surveys were conducted between 2013 and 2015 as part of the monitoring activities aimed at drawing up of 19 of the N2000 Sites Management Plans in southern and interior Abruzzo, for which were not already included species of bats in the Standard Data Form. The monitoring protocols provided under Measure 323 PSR 2007–2013 in the Abruzzo region included surveys in the Sites where previously bat species of Community interest were reported.We extended monitoring also in the Sites without bat data in the Standard Form.

Surveys were preliminary and non-exhaustive, aimed at a first definition of conservation priorities and the local protection measures. The surveys were conducted through inspections in natural underground cavities, artificial underground cavities and ruins; the bio-acustic detection with Pettersson D1000x was used.

Preliminary investigations have thus enabled to detect at least one taxon of Annex II to the Directive 92/43/EEC in 12 of 19 sites (63.2%). 7 species of Annex II have been detected: *Rhinolophus hipposideros* (8 sites, 42.1%); *Rhinolophus ferrumequinum* (5 sites, 26.3%); *Miniopterus schreibersii* (2 sites, 10.5%); *Barbastella barbastellus* (2 sites, 10.5%); *Rhinolophus euryale* (1 site, 5.3%); *Myotis blythii* (1 site, 5.3%); *Myotis myotis* (1 site, 5.3%). Preliminary data also allowed the detection of 8 species included only in Annex IV: *Pipistrellus kuhlii* (18 sites, 94.7%); *Pipistrellus pipistrellus* (12 sites, 63.2%); *Hypsugo savii* (11 sites, 57.9%); *Nyctalus noctula* (5 sites, 26.3%); *Tadarida teniotis* (3 sites, 15.8%); *Myotis nattereri* (2 sites, 10.5%); *Pipistrellus pygmaeus* (1 site, 5.3%); *Eptesicus serotinus* (1 site, 5.3%).

We believe that the different species detection rate was conditioned by different easy to identify, being underestimated taxa characterized by higher levels of acoustic signals overlapping (e.g. taxa of the genus *Myotis*). The detection of the species *R. hipposideros* was frequent, despite a scarse number of individuals, because of a dispersed distribution in available refugee sites, mainly consisting of accessible ruins.

The survey concerned the first inspection of the Grotta del Lupo an extensive gypsum cave discovered in 2013 on the Site of "Monte Sorbo (Monti Frentani)" IT7140123 (CH), where the presence of *R. ferrumequinum* ($\geqslant$ 5 ind.), *M. schreibersii* ($\geqslant$ 250 ind.), *M. blythii* ($\geqslant$ 250 ind.) and *M. myotis* ($\geqslant$ 500 ind.) were detected. The preliminary data shows an unexpected importance of Sites monitored, with particular reference to the Frentani Mountains (southeast of Abruzzo region) that would require further investigation for a complete knowledge on the populations and on the presence of caves of particular conservation interest.

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Relazione tra attività zootecniche e lupo (*Canis lupus*) in Lessinia

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Il ritorno spontaneo del lupo (*Canis lupus*) nel territorio della Lessinia è stato documentato per la prima volta a gennaio 2012 a mezzo di riprese in foto-trappola. Il territorio della Lessinia si estende tra le province di Verona, Trento e Vicenza, contenendo al suo interno il Parco Naturale Regionale della Lessinia (PRNL). I campioni biologici analizzati attestano che l'individuo ripreso era una femmina con aplotipo italico. Nella primavera del 2012 si è assistito alla lunga dispersione di un soggetto di origine dinarico-balcanica, partito dalla Slovenia nel dicembre 2011 arrivato in Lessinia nel marzo 2012. La formazione della coppia viene accertata nell'aprile 2012, grazie ad una sessione di *snowtracking*, confermata dalla raccolta di campioni biologici e fotografie nei mesi successivi. A partire dal 2013, sono stati confermati 3 eventi riproduttivi: 2 piccoli nati nel 2013, 7 nel 2014 e 7 nel 2015. A gennaio 2016 il branco contava 13 individui, a cui si aggiungono due individui nati antecedentemente al 2015 nelle zone limitrofe al territorio occupato dal branco.

Per stimare l'estensione dello spazio famigliare è stato applicato il metodo del minimo poligono convesso, inizialmente usufruendo dei dati provenienti dal collare GPS del Progetto Life SloWolf nel 2012, poi per integrazione con i segni di presenza di monitoraggio per gli anni 2014 e 2015. Nel 2015 branco ha coperto un territorio pari a 170 km^2, occupato per quasi l'87% da aree naturali e semi-naturali (in particolare foresta di latifoglie, 36.8%, e praterie naturali, 36.7%) per il 2.65% da aree antropiche.

Per valutare la pressione predatoria sulla componente zootecnica sono stati analizzati i dati di predazione dal 2012 e le caratteristiche delle singole predazioni del 2014 e del 2015, per la provincia di Verona, attraverso l'utilizzo dei verbali di predazione redatti dagli addetti ai sopralluoghi (PNRL e CFS). Sono stati esaminati tramite *software* GIS gli usi del suolo (CORINE Land Cover) relativi al territorio intero e ai punti di predazione per gli anni 2014 e 2015 utilizzando differenti aree *buffer* di raggio 250 m e 500 m. Le aree delle predazioni con *buffer* 250 m presentano come media delle percentuali di copertura il 75.1% a pascolo, il 20.5% a foresta (latifoglie, conifere e mista) ed l'1.4% da strutture antropiche. Rispetto ai *buffer* di 500 m le diverse predazioni sono localizzate in aree rappresentate da pascolo 68.5%, 26.3% foresta e 1.7% ad edificato antropico.

In Lessinia monticano ogni anno tra i 6000 e 8000 animali (nel veronese i capi in monticazione censiti dalle ASL locali sono stati nel 2014 5580 e 3879 nel 2015), la quasi totalità bovini. Le predazioni su domestico sono state nel territorio veronese: 17 (5 bovini, 8 pecore e 4 capre) nel 2012, 11 (9 bovini e 2 asini) nel 2013, 54 (39 bovini, 10 asini, 3 pecore, 1 capra ed 1 cane) nel 2014, ed infine 48 (43 bovini e 5 asini) nel 2015. Le località maggiormente soggette a reiterazione di eventi predatori nel 2014 e 2015 sono 3 su un totale di 50 siti soggetti ad attacchi. Complessivamente il tasso di predazione è risultato pari a meno dell'1–2% della popolazione monticata. Nel territorio trentino le predazioni si attestano a 7 (6 bovini e 1 asino) nel 2013, 12 (9 bovini e 3 asini) nel 2014 e 12 (9 bovini, 1 asino e 2 cavalli) nel 2015.

Per la provincia di Verona nel 2014 il successo predatorio è stato pari al 72% con 39 capi uccisi (28% feriti e soppressi), e nel 2015 pari all'88% (12% tra feriti e soppressi). Sono state analizzate le classi di età dei bovini attaccati, dividendole in scaglioni di 6 mesi fino all'età di due anni; per il 2014 le percentuali di predazione sono: 0–6 mesi 38%, 6–12 mesi 40%, 12–18 mesi 13%, 18–24 mesi 8%, >24 mesi 0% (3% non pervenuta l'età); per il 2015: 0–6 mesi 33%, 6–12 mesi 42%, 12–18 mesi 16%, 18–24 mesi 2%, >24 mesi 7%.

Nel territorio del branco è stata osservata la presenza di diverse specie di ungulati selvatici: caprioli, cervi, cinghiali e camosci; in riferimento a queste specie nell'area del parco non sono presenti studi sulla densità, ma solo risultati dei censimenti svolti fuori dalla zona parco per la realizzazione dei piani di abbattimento relativi all'attività venatoria. Al fine di migliorare conoscenza e accettazione di questo branco risulta in futuro importante determinare la quota di componente della dieta riferita alle specie selvatiche e domestiche, l'uso stagionale differenziale dell'area e supportare le attività zootecniche attraverso assistenza tecnica, sostegno economico a fini di risarcimento ed opere di prevenzione, come già in parte avviene per intervento della Regione Veneto e provincia di Trento.

Si ringraziano il PNRL e Comunità Montana della Lessinia, la stazione C.F.S ed il Comune di Bosco Chiesanuova, la Provincia di Verona, la dottoressa Bragalanti del MUSE, ed il progetto Life WolfAlps.

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Camera trapping in the Regional Park of Murgia Materana

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The aim of this study is to present preliminary results achieved during camera trapping sessions carried out in 2015 within the monitoring project of wolf population (*Canis lupus*) in the Province of Matera (Basilicata region, South of Italy). The study area is located in the Regional Park of Murgia Materana (6128 hectares, headquarter coordinates: 40° 39' 59.35" N, 16° 36' 34.53" E).

3 different camera stations were chosen within the park based on spatial distribution of wolf signs in order to detect the presence of the carnivore.

The effort was of 291 trapping days (Σ Number of Camera-trap $\times$ Days of activities). A total of 517 videos/photos were recorded of which 459 caught the presence of the wild fauna of the area. Animal of the same species recorded in the same camera station during a period of 30 minutes, were considered a single event. Observed wild mammal species were: *Canis lupus*, *Vulpes vulpes*, *Felis silvestris*, *Sus scrofa*, *Hystrix cristata*, *Meles meles*, *Martes foina*.

Capture Rate and Relative Abundance Index (RAI) were estimated for each species. Daily activities patterns of prey and predator species, and those of faunal and human presence were calculated and compared.

Our results showed that camera trapping technique was useful to understand the composition of mammal community in the Regional Park of Murgia Materana, thus confirming the effectiveness of this technique to detect the presence of cryptic animals.

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Presence and status of *Lynx lynx* in the Ossola valley (western Italian Alps)

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The autochthonous population of Eurasian lynx in the European Alps became extinct by the first decades of the 20th century. From the 1970s onwards the animal was reintroduced and European Alps are currently considered to be inhabited by a meta-population which is still well below the optimum level. The aim of the present study was to update and discuss the information available on the species in the northerly portion of the River Toce basin (Piedmont). Two procedures of field research were applied: the naturalistic method and the method of photo-capturing. The nat-meth was implemented over the study period 12.03.09–11.03.15 with a sampling effort of 1010 km transects distributed in a study area 136.5 km^2 extended; for phot-meth 4 different cameras were placed at 6 spots for the study period 01.03.13–04.04.15 with a sampling effort of 369 trap days. Nat-meth produced 18 signs of the presence clusters (a cluster was referred to a number of sign of presence non reciprocally independent in time and space); by phot-meth we obtained 7 captures. All data were compatible with the presence of two individuals, one "bigger" with coat pattern concolor, the other "smaller" and spotted; we considered them as adult males on the basis of the relative proportion of the body parts. Publication of two sets of photo-captures obtained in 2014 and 2015 by other AA confirms the presence of the two adult males, concolor bigger and spotted smaller, in the study area. Thus between 2013 and 2015 such area was inhabited by at least two adult male lynxes, without any evidence of reproductive activity (presence of adult females and kitten or not emancipated young) . The comparison between the present study and two other leads to statistically not significant differences between the resulting relative abundances of the lynx in the study area: Kia (kilometric index of abundance = total number of presence signs collected / total number of kilometers walked on transects) of 1991–94 study = 0.014 and of present study = 0.018 (Jacobs indexes: 0.15 the first and -0.12 the second); Tia (trapping index of abundance = total number of photocaptures / total number of trap days elapsed) of 2013–14 studies, by others = 0.06 and by us = 0.05 (χ^2=0.22; p=0.86). All that prompt us to hypothesize that the population of lynx in the upper Ossola Valley has not changed much in the last 20 years, in terms of both local area and number of individuals. We estimated the reference area in which these two animals most probably moved in 2013–15 by buffering the minimum convex polygon containing all the locations ascertained by means of phot- and the nat-method: it ranges from 191 to 207 and 223 km^2, that fall within it. Among the geographic landscape of these areas, the principal components supporting the bio-ecology of the species are: wood and/or shrub and/or bush vegetation at any altitudes; spontaneous herbaceous areas below the tree-line; all of them 500 meters away of continuously inhabited human settlements. Taken together these conditions cover 72.9% of the reference area. The three possible areas that are suitable for the Eurasian lynx are therefore of 139, 151 and 163 km^2. On the basis of what has been discussed above, in the period 2013–2015 the lynx minimum densities would range from 0.9 to 1.44 individuals/100 km^2. In north-western Swiss Alps, the sub-region which currently harbors the most abundant lynx population the density "in all habitats" results: 1.0–1.51 animals/100 km^2. These data further strengthen the hypothesis that the situation of the Eurasian lynx in the study area is fairly stable. The source of origin of the deme in the Ossola Valley sink can only be the population of the south-western Swiss Alps. Nevertheless, the 20 years that have elapsed between the first and the latest surveys of the lynx presence in this area have evidently not been sufficient for the formation of a local population. This situation, however is not in contrast with the pattern of range expansion of this feline, which is extremely slow and conservative, very unlike the pattern displayed by a carnivore of similar size, like the wolf, which is rapid and expansive. By the conservation point of view, we suggest that the regional and national Authorities responsible for the use of the territory should maintain the area of the Italo-Swiss border and the bottom-valley zones of the River Toce basin in a good state of conservation, naturalness and ecological continuity. Moreover, we recommend that permanent monitoring of the presence and distribution of lynx be implemented and that the study area be extended as far as possible.

X Congresso Italiano di Teriologia

Wildlife Economy *alias* new Paleolithic: the keystone role played by Mammals

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Today, most of the territory of Italy, Europe and other "developed" regions of the Planet, is still constituted by areas where agronomic activities (agriculture, animal farming, forestry) are or were carried out. Since the 1960s, increasingly large portions of rural land have been abandoned, both on account of changing socio-cultural models and because high production costs and the relatively low retail prices imposed by the market have made agronomic activities increasingly unviable economically.

With regard to those rural areas that have been unused for agronomic purposes for varying lengths of time, the question arises as to whether they should really be considered "unproductive" and therefore unable to function as primary sources of food, income and employment.

Ecologists and environmentalists claim that rural areas no longer used for agronomic purposes nevertheless provide ecosystem services, one of the most touted of which is safeguarding biodiversity. In reality, however, the terms "ecosystem services" and "biodiversity" cannot easily and directly be connected with the provision of income and employment for those who manage such areas.

The strategic objective of WE (Wildlife Economy) is to produce goods and services, income and employment through the sustainable use of the wildlife populations living in rural areas.

This proposal stems from the realization that wildlife is a product of the land. Albeit spontaneous and not cultivated or raised directly by man, wildlife is no less bound to the land than cattle, pig or poultry farms. The earth produces plants, on which wild animals feed, and these animals are a source of food for other wild animals. In the same way, the earth produces the legumes and grasses that man cultivates to feed the cattle, pigs and poultry that he eats.

Within that scenario wild mammals play a primary role: Wild boar, Red deer, Roe deer, Fallow deer, Chamois, Alpine ibex, Mouflon, Hare, and many other species live wild in natural, semi-natural and cultivated areas in Italy, Europe et cetera. They constitute a constant, spontaneous, high-quality animal biomass, which is biological in the strict sense, without any direct or indirect intervention by *Homo sapiens*.

In the Paleolithic Age, this "wise man" long exploited natural living resources fully, especially wildlife, just as the present project proposes to do. The adjective "new", however, is indicative of the modernity of its technical, scientific and sustainable approach.

The economic exploitation of wildlife is not limited to the primary production of food of the highest nutritional and organoleptic quality; it extends to other at least 31 well defined activities: hunting, naturalistic, scientific, educational, recreational, touristic and so on. If planned and organized appropriately, these are all reciprocally compatible, synergetic, integrated and are able to generate income and employment. In this case the set of wild mammal species suitable for economic sustainable use grows exponentially encompassing almost all *taxa* present in a sub-regional, regional, national, continental area, from Insectivora to Carnivora, Chiroptera et cetera. A lot of them of highest degree of charismatic attractively among the wild fauna in the whole.

The sustainability of the economic use of species, populations and their habitats founds a strategic base on the "carrying capacity" (K) concept-device. The constant, concrete, realistic searching of the best K-value of these living resources should be connected with the practical application of taxonomic, field monitoring, demographic evaluation techniques on the species and populations in use. Within them the quality, quantity and cost of the used procedures should be calibrated in order of the taxon and/or deme sensibility and the type of economic use in program.

Last but not least, the NP (New Paleolithic) should not be seen as an antagonist or competitor of agronomic activity. Rather, it is to be considered complementary, integrative and/or substitutive. Moreover, the land encompassed by the NP will conserve and enhance its potentiality for agronomic use.

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Twenty years after: the global state of the art of the Italian hare (*Lepus corsicanus*) management and conservation

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Twenty years ago, Fernando Palacios published a scientific paper where described the morphological differences between the Italian hares traditionally identified as *Lepus europaeus*, and proposed to re-consider the taxon *corsicanus* as a good species. Since then, many informations have been collected on molecular, morphological and ecological characteristics of the specie; however, some issues are still poorly understood (i.e. the actual distribution of the Italian hare in continental Italy and the ecological needs). Furthermore, the surveys and the research carried out in these 20 years have not always found an application in orienteering suitable conservation measures. In this poster we describes the actual state of the art of management and conservation of the Italian hare both in its native range, and in the introduction one; furthermore we performed an analysis of the potential distribution of the species, in order to propose local level management actions. To assess the global distribution of the species, we collected the recent (after 1996) information on the distribution of the species and assigned the georeferenced ones to an UTM grid (1×1 km). Data where gathered by means of direct observation (diurnal or night-time spotlight), photos, specific published and unpublished paper on hares distribution, visual examinations of hunted hares, occasional observations and expert interviews. The actual distribution of *L. corsicanus* extends from Grosseto southwards to Calabria, and the Sicily; in continental Italy, verified records are reported for Tuscany, Umbria, Latium, Abruzzi, Molise, Apulia, Basilicata and Calabria. However, the northernmost observations in Grosseto province (Punta Ala and Prata), are based on two single records and they need to be verified by means of a more continuous sampling. In Corsica the species must be considered alien, it was introduced presumably before the 15th century using individuals from central Italy, and its actual distribution covers three distinct parts of the island: the southern three quarters of Haute-Corse (that hosts the 97% of the total range), Cape Corse and Sagone. In the autochthonous range, the species displays a geographical structured conservation status: in Sicily it is widely distributed and with good density of populations (>10 ind/km^2); however, in continental Italy *L. corsicanus* is reduced to small sized and isolated populations. Moreover, in continental Italy, the species lives almost everywhere in sympatry with *L. europaeus*. In the allochthonous range, it shows a population increase in the main range of Haute-Corse, in the other two areas of presence, the status of populations is much more precarious. The legal status of *L. corsicanus* varies according to the considered, too. In continental Italy the species is protected, in Sicily it is a game species (only on the basis of a quantitative hunting plan), in Corse it is a game species.

The main threats to conservation of *L. corsicanus* in continental Italy are the small size of populations, the fragmented distribution of populations, and the illegal hunting; however, a key role is played by the *L. europaeus*. In fact, several thousands of European brown hares, has been introduced, since the twenties of the XX century, for hunting purpose in the native distribution area of *L. corsicanus*. This persistent release of European brown hare, which can compete for resources and transmit diseases when in simpatry with the autochthonous species, could worsen the conservation status of peninsular populations of *L. corsicanus*. Moreover, in Corsica have been discovered a few of hybrids resulting from crossbreeding of the Italian hare with European brown hare and the Iberian hare (two other species alien to Corsica). Consequently, the release of captive-bred or translocated European brown hare should be avoid in native and Corsican distribution range; furthermore in continental Italy and in Cap Corse and Sagone, considered the small size of populations, to prevent further loss of genetic diversity and increase of inbreeding, should be performed habitat restoration and expansion of ecological corridors programmes. The suitability model we performed for Italy and Corsica represents an useful tools to identify areas where ban introduction or restocking of European brown hare and where implement ecological corridors. Furthermore, for Corsica and Sicily where Italian hare is a game species, it is urgent to improve suitable methods to estimate actual population densities and plan a sustainable harvest. In Corsica, major effort should be done to identify and remove all the hybrids as possible.

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Monitoring wolves in badlands and Murgia area

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During the last decades, Italian wolf population (*Canis lupus*) had a great recover, from the estimation of nearly extinction in 1970s (about 100 individuals all other Italy), to the last estimation of 1200–1800 animals in 2015, occupying now the whole Apennine Chains and the Alps. Several monitoring studies were conducted mainly in mountainous area, but very little is known about wolf presence in different habitat, such as badlands and Murgia area in South Italy. From 2013 the Regional Observatory of Natural Habitats, Wildlife, and Biodiversity in cooperation with the Regional Park of Murgia Materana and the association Movimento Azzurro of Matera, started the monitoring project of wolf population in the Province of Matera (Basilicata). Preliminary results concerning the first years of monitoring activities are presented in this paper. The assessment of the abundance of the wolf population was carried out by non-invasive monitoring techniques: genetic analysis, wolf-howling and camera trapping. Due to the lack of snow, it was not possible to perform snow-tracking. In a study area of about 900 km^2, 15 transects of variable length ($\overline{x}$=10.9 km) were established and performed to find signs of presence of the carnivore. Biological samples (85 scats and 9 tissues samples) were collected for genetic analysis. During the first year, were genotyped 7 distinct wolf in the area, albeit the remaining samples still have to be analyzed. Wolf-howling permitted to evaluate breeding success of 2 wolf packs in the year 2014, and of 1 wolf pack in the year 2015. Camera trapping was used sporadically for lack of equipment, but it was useful to estimate the minimal size of the pack and the occurred reproduction. We estimated the presence of at least 3 wolf packs in the study area and the maximum pack size recorded by camera-trapping method was 5 individuals. Further studies are needed to confirm these results. In particular genetic analysis of biological samples collected in the second and third year of monitoring activities will be essential to understand the real consistence of wolf population in the area.

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Estimation of ungulates density through the integration of different techniques in Friuli-Venezia Giulia region, North-East of Italy

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The Friuli Venezia-Giulia region is located in the northeast of Italy, along the border with Slovenia and Austria and includes three bioregions: Alpine, Continental and Mediterranean. The aim of the study was to test and integrate different techniques to estimate the density of roe deer (*Capreolus capreolus*), red deer (*Cervus elaphus*) and wild boar (*Sus scrofa*) in alpine and pre-alpine areas and karstland. We have compared different methods: camera trapping (with Rowcliffe formula) and the track count based on Russian Formozov-Malyshev-Pereleshin formula in respect to hunter spring census. For each area we have identified two different game reserves, for each we have chosen four transects of 1 kilometre long, representative of the habitat, in which, every fifteen days and from December 2014 to March 2015 we have recorded all indirect signs. Four camera traps were placed for each reserve. The mean density of ungulates surveyed from hunters were: roe deer 10.97 head/100 ha (min 3.40–max 21.34); red deer 2.18 (min 0.45–max 3.92); wild boar 1.54 (min 0.30–max 2.86). Data were analysed through the mixed model testing the species and the techniques effect (within species), regarding game reserves as a random result. Roe deer density is significantly different in respect of red deer and wild boar, while density of red deer is not significantly different with that of wild boar. The track count method (D3Tracce), considering the travelled daily distance deduced from literature data, ensures a density that, in the three species considered (roe and red deer, wild boar), is not significantly different from the reference hunters' density. Camera trapping could not identify species at low densities because the detection probability is lower. At low densities, the track count technique is related to the ungulates density measured by hunters, especially in regarding to red deer (R^2=0.91; p<0.05); camera trapping seems more related for high densities estimated by hunters (roe deer, R^2=0.83; p<0.05). The daily distance travelled influences the accuracy of estimation of the two techniques. We discuss the results of this approach and the limits and challenges for each method in relation to different environmental conditions (i.e. detectability), different species and the importance of the integration of the photo trapping and track counts.

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Monitoring the biodiversity of a regional park through citizen science: the project of the Oglio Sud Park

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Citizen Science platforms for collecting wildlife records are spreading in the last years, also due to the diffusion and the upgrade of smart phones and internet connection systems and are allowing scientists to access to distributional data banks built with the help of citizens. Among the principal platforms, the most used in Italy are Ornitho and iNaturalist. The Oglio Sud Regional Park (about 13,000 ha) is located along the downstream part of the Oglio river (Provinces of Cremona and Mantova, Lombardy, Northern Italy). This park built up a project on biodiversity assessment through the iNaturalist platform (www.inaturalist.org) since Autumn 2015 that cover the area of the park and of the neighboring municipalities. This platform shows a number of advantages with respect to other ones, such as: a total covering of the life forms; the possibility to select and create the area of the Park and to upload photos in different formats and sizes; the availability of smart phone applications for the operative systems Android and iOS and its software totally open source and open access. The whole dataset is available for registered and unregistered users, and records with photos, date, location and the agreement of users in the identification, will automatically be uploaded on GBIF (www.gbif.org). Records of vulnerable/protected species are displayed with an error of 10 km on the accuracy of the location. The social network structure of the platform, where observations are confirmed by the global community, allows citizen to be integrated within the data collection and identification processes. So data collected through this project might be also shared with other projects on iNat, thus expanding the utility of each observation. In its first five months, 8 users participated to the project, with a total of 2,168 observations and 268 species. Mammals represent the 5% of the observations, with 17 species of the 35 reported for the area: Western Roe Deer *Capreolus capreolus*, Common Hedgehog *Erinaceus europaeus*, Lesser White-toothed Shrew *Crocidura suaveolens*, Savi's pipistrelle *Hypsugo savii*, Gray big-eared bat *Plecotus austriacus*, Natterer's bat *Myotis nattereri*, Northern Raccoon *Procyon lotor*, Stone Marten *Martes foina*, Least Weasel *Mustela nivalis*, Eurasian Badger *Meles meles*, Red Fox *Vulpes vulpes*, European Brown Hare *Lepus europaeus*,Crested Porcupine *Hystrix cristata*, Black Rat *Rattus rattus*, House Mouse *Mus musculus*, Eurasian Red Squirrel *Sciurus vulgaris*, Coypu *Myocastor coypus*. The number of contributions to the project is growing thanks to the Volunteer Ecological Guards of the Park. Given that the park is surrounded by highly anthropized areas with intensive agriculture and breeding farms, as well as by a dense net of highways, mapping the distribution of recently arrived species (*C. capreolus*, *P. lotor*, *H. cristata*) may provide further suggestions to the management of species and habitats. Knowledge on species distribution is a fundamental requirement for a protected area and an important goal to be achieved also with the involvement of citizens. Thus, the use a platform like iNaturalist which allow specialists to involve citizens in adding relevant data on species distribution, by teaching them how to distinguish taxa and their ecosystemic roles.

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The European wildcat (*Felis silvestris silvestris*) in the Biogenetic Casentinesi Natural Reserves, northern Apennines

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The European wildcat (*Felis silvestris silvestris*) is one of the most elusive carnivore in the Italian peninsula. It is threatened by the habitat fragmentation, poaching and hybridization with the domestic cat (*Felis silvestris catus*). A sound knowledge of population parameters and genetic status is essential for its conservation. In this study we present some results of the survey carried out in the period July 2014 – August 2015, in the Biogenetic Casentinesi Reserves, as continuation of the investigation started in 2008 by the Biodiversity Office of Forestry Administration of Pratovecchio. In this work we applied in an area of about 20 km^2, a photo-trapping protocol combined with a non-invasive genetic sampling using hair-traps, baited with *Valeriana officinalis*, and an opportunistic scat collection. We collected a total of 99 video-captures of the target species, on a total sampling effort of 2967 nights/trap. Moreover, we collected 54 biological samples (15 scats and 39 hair samples). Biological samples we subjected to genetic analysis at the genetic laboratories of ISPRA to determine the subspecies and the individual genotype. Analyzing the video-captures we identified 13 different Wildcat individuals, the genetic analyses provided 7 different genotypes attributable to *Felis silvestris silvestris*. The use of Valerian-baited lures was effective in increasing the capture's probability of the target species but only few individuals showed a rubbing behavior leaving hairs on the traps. This seems to support the hypothesis of a genetically-based reaction.

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Census of *Myotis myotis/blythii* and *Miniopterus schreibersii* colony in a mine based on thermal imaging

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In this study we present data collected from a reproductive bat roost located in an abandoned sulphur mine in Canale Monterano municipality (Latium, Central Italy). We discovered the roost during our researches for the SCI IT6030001 "Mignone River middle course' management plan. This site is nearby the SCI and the Monterano Nature Reserve. No data about the roost was present in scientific literature until now.
The colony has been studied since summer 2004, but since summer 2013 standardised surveys have been done. A first count has been made in July 2013 through visual assessment by 2–3 observers positioned near mine entrance during emergence flights. Then, from August 2013 to June 2015, we made four counts through thermal imaging. The videos were recorded to confirm the counts. After the emergence flights we made surveys inside the mine to verify the presence of non-flying juveniles. We confirmed a reproductive *Myotis myotis/blythii* and *Miniopterus schreibersii* colony, in which the first species were more abundant.
Thermal imaging method revealed a bigger estimate of bats than visual assessment, limited by low ambient light condition. The colony size is estimated between 5194 (June 2015) and 6625 (June 2014) adult bats.
The colony size and the involved species allow to classify the roost as one of national importance according to GIRC (Italian Chiroptera Research Group) criteria.
According to the collected data, we proposed to include this site in SCI IT6030001 and to update the Natura 2000 standard data form.

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Microtus savi tunnels host other species of small vertebrates

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The Savi's pine vole *Microtus savii* (De Sèlys Longchamps, 1838) moves and feeds in a complex system of tunnels not too deep in the soil. Even if it moves over the soil, exploring part of his territory, searching for food or to find other tunnels, *Microtus savii* is predominantly active under the soil.
M. savii is known to prefer open habitats as grassland or shrubland and represents the most widespread and abundant species in agricultural landscapes in Italy. In the framework of a wider study on ecology and spatial behavior of the species, an extensive trapping was performed during a whole year to perform a capture – recapture study. During this activity some other small vertebrate species were trapped from the same tunnel of *M. savii*.
The study area was located in a grassy peach orchard of 3 ha in the countryside of Imola (BO) where between 80 and 100 Ugglan Special traps where used for 6 consecutive days. All holes were closed in the field and later traps were exposed and activated at each entrance the day after the vole re-opened the hole, to make sure to try to catch only in front of active tunnels.
In front of the *M. savii*'s tunnels following species were trapped: the Soricomorpha *Crocidura leucodon*, *Crocidura suaveolens*, *Sorex samniticus*, *Talpa europaea*, the Rodentia *Microtus arvalis* and *Apodemus sylvaticus* and the Amphibia *Bufotes viridis*.
The two *Crocidura* were trapped more frequently during the warm months whilst *S. samniticus* show an inverse distribution and was more often trapped during cold months. *T. europea* use the tunnel systems just during the springtime and summer. *M. arvalis* was caught only for a short period of time in March and April. *A. sylvaticus* was present in all months except May and June and more numerous during cold periods. In September one adult male of *B. viridis* was also trapped, probably leaving a refuge used in warmer and dry days before.
The small diameter of the tunnels do not exclude a larger than expected number of species that use the system created by the fossorial voles for both refuge, corridors and probably for food search.

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Migrant or refugee? *Microtus arvalis* band to the southernmost limit of Italian distribution

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Microtus arvalis (Pallas, 1778) is one of the native rodent species in Europe with larger range. It is distributed from Spain across much of western, central and eastern Europe and reaches the Middle East and central Russia. Does not colonize the northern parts of Europe and also the more Mediterranean regions. The species prefers open habitat dominated by grasses and meadows, from the sea level to 2600 m in elevation. This vole is considered common throughout its range, with population densities that can reach 1000 individuals per ha in peak years, followed by rapid decreases. During these outbreaks can become a serious agricultural pest in some areas.

In Italy the populations had provided a different genetic lineage, at least at level of a separate subspecies and a systematic re-arrangement have still to be completed. At the actual state of the art is known to be distributed from Friuli, Trentino Alto Adige, Veneto, Lombardia and few sightings for Piedmont and Valle d'Aosta. The southern distribution limit occur in Emilia Romagna in the province of Piacenza, Parma, Reggio Emilia, Modena, Bologna, Ferrara and at the border of Ravenna.

During a year-long trapping research on *Microtus savii* (De Sèlys Longchamps, 1838) in Imola surroundings (BO) where was supposed that the Savi's vole was the only Microtidae present, in March and April 2015 we captured a small number of *M. arvalis*, adults of both sexes. During the research 183 Uggland traps were used for 6 days a month and 1331 *M. savii* were captured and released. Unexpectedly in March we had 3 and in April 18 captures of *M. arvalis*, but nothing more in the following month of May and June. *M. arvalis* represents 1.5% of the whole number of captures, and in just 2 months. As the species is known to provide large numerical fluctuations we suspect that the rest of the populations, that is known in localities distant at least 20 km at North, 35 km at North-East and 45 km at North-West are locally increasing and group of new founder are also moving to south along at least the valley of Santerno river. The competition in this marginal environment seems to be still favorable more to the dominant *M. savii*. Actually a study of the local distribution of the two voles is undergoing.

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Studies on carnivores conferred to Istituto Zooprofilattico of Forlì in 2013-2015

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Carnivore represent the typical umbrella species in terms of conservation and for the human dimension in conservation biology. This role can be also considered for the environmental heath as they tend to accumulate, in some respects, the parasitic diversity, contaminants and also to be very sensitive to human related pressures.

To evaluate this role and as a part of the project here we report on the last three years of investigations carried out on specimens of wild carnivores received by the Institute in Forlì.

In this first report we do not consider foxes as their status and conferment cases, related to control plans and the regional wildlife health control plan need a different approach.

From 2011 to 2015 15 wolves *Canis lupus* were brought to the laboratory for analysis, the 19% of the whole number for the same years in both regions. They were 1 in 2011, 2 in 2012 and 2013, 4 in 2014 and 6 in 2015. The increase in number is related both to the widespreading of the specie to lower parts of the Apennine's valleys, in more close contact with human activities, and also due to the increase of attention to evaluate the animals found dead in the territory.

Like for others wildlife also wolves have a lot of vehicles casualties but the poisoning is still the main cause of death, with different active ingredients, especially organochlorine pesticide. 8 cases resulted positive for *Escherichia coli* in intestine, as well as in 15 intestinal helmints were recognized. Also sarcoptic mange was found on carcasses coming from the border with the Marche region, were is also widespread on *Vulpes vulpes*. Among ectoparasites were found *Ixodes ricinus* and *Rhipicephalus turanicus*.

Among Mustelidae, the *Meles meles* numbers are between 3 and 1 in 2011 and 2012 respectively to 22 in 2015, summing 40 specimens, 13% of the total of the 2 regions. All specimens arrived from road casualties. In 9 cases etiological agents were identified: *Citrobacter freundii* (2), *Edwardsiella tarda*, *Enterococcus faecalis*, *Enterococcus faecium/durans*, *Escherichia coli* (6), Genus *Shigella*, *Serratia liquefaciens* and also 1 case with *Salmonella typhimurium* (no evidence of symptoms) and one of *Yersinia pseudotuberculosis*.

Just one *Martes foina* arrived in 2015, an adult male crashed on road, around 1% of the whole number checked in the two regions in 5 years. In the specimen *Citrobacter koseri* was isolated. In these years in all the sections 98 specimens were checked, the majority in Sondrio and Binago, as ever mostly from car traumas. Other 16 different etiological agents were also identified in the other cases, as well as sarcoptic mange in Alps.

Unexpected also a *M. putorius* carcass came in late 2015 near Ravenna from the road. The species was considered in rarefaction and this new case bring back the attention to the actual status. No *Mustela vison* where checked despite the species still has a stable population on the Ronco river and for which it is not in place unfortunately any control plan.

Only one *Felis silvetris* was checked, anyway an important witness of the local increasing population, also found dead on the road, where one of the *E. coli* strain was found.

The attempt to collect new information about the potential role of wildlife in the increasing "new" diseases as well as the diffusion of zoonosis and relationship along with the livestock sector and the presence in urban centers are discussed in the light of the "one health" concept.

Thanking all the crew helping in analysis and data management, this work is part of the project "*Inurbazione della fauna selvatica, sinantropi e possibile rischio zoonotico*" currently in progress.

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Effects of pasture depletion on feeding intensity, maternal cares and survival of the Apennine chamois

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On the warm months, i.e. during nursing and weaning, access to high-quality forage is crucial for growth and winter survival of offspring, in ungulates. Pasture depletion could be expected to affect the foraging behaviour of females, with cascading effects on maternal cares and offspring survival. To test this prediction, we have evaluated the effects of pasture depletion on foraging behaviour of adult female Apennine chamois *Rupicapra pyrenaica ornata*, suckling behaviour of chamois kids, as well as kid survival. We have compared aspects of foraging/suckling behaviour and kid survival across three areas with different pasture quality (Areas A-B: "poor", depleted pasture, i.e. with a reduced availability of nutritious forage; Area C: "rich" pasture).

Through behavioural observations, in Areas A-B we recorded (i) a lower feeding intensity of female chamois (indexed by bite rate), in summer-autumn; (ii) a lower suckling success of chamois kids (number of suck bouts/number of suck attempts); (iii) lower frequency of suck bouts (n. suck bouts/kid/h); (iv) lower suckling intensity (time suckling/kid/h); (v) lower kid survival, in respect to Area C. Resource exploitation by red deer *Cervus elaphus* and environmental changes in secondary meadows, leading to the spread of unpalatable plant species in sites at comparatively lower altitude, have been shown as mechanisms triggering pasture depletion in Areas A-B.

In ungulates, resource scarcity has been suggested to induce adult females to decrease maternal cares and favour their own maintenance. In turn, maternal investment should decrease, leading to a lower growth and survival of offspring. In the long-term, negative effects would result on population dynamics. Our results suggest that pasture depletion, induced by interspecific competition and environmental changes, can affect the survival of an alpine ungulate, through their negative effects on foraging behaviour of females and suckling behaviour of kids.

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Progetto LIFE Strade: elaborazione delle carte del rischio ed efficacia degli interventi di prevenzione in Umbria

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Dal 2013 la Regione Umbria è beneficiaria e capofila di un progetto Life per la prevenzione degli incidenti stradali con la fauna selvatica (LIFE11BIO/IT/000072; `www.lifestrade.it`) che vede partecipare tre Regioni (Umbria, Toscana e Marche) e cinque Province (Perugia, Terni, Siena, Grosseto, Pesaro Urbino). Nel corso del 2014 è iniziata la sperimentazione dei primi dispositivi per la prevenzione delle collisioni: si utilizzano i dati di una serie di sensori IR per il rilevamento degli animali prossimi alla carreggiata e due radar doppler per le auto in transito. Una centralina raccoglie entrambe le segnalazioni e provvede ad attivare una dissuasione acustica per gli animali o una luminosa per i conducenti nel caso ci sia contemporaneità nell'attivazione. Tutti i dati delle attivazioni dei singoli sensori e degli apparati di dissuasione/avvertimento sono trasmessi tramite una SIM dati sotto forma di mail ad un server remoto. In ogni Provincia vengono condotti rilievi e mappatura GIS della viabilità, degli incidenti con la fauna selvatica e della presenza di carcasse lungo le strade, elaborando i dati con l'algoritmo *Habitat Suitability* di Biomapper per produrre carte del rischio, sia quello reale che quello potenziale in base alle caratteristiche ambientali. Nella fase iniziale del progetto, si sono utilizzati i dati per l'individuazione dei tratti in cui collocare i dispositivi di prevenzione e serviranno in futuro per altri interventi di riduzione e mitigazione del rischio. In Umbria, su circa 4300 km di rete viaria fra strade statali, regionali e provinciali, negli ultimi 10 anni sono stati denunciati ben 3422 incidenti (di cui il 56% con cinghiali e 30% con caprioli, entrambe specie molto diffuse e con consistenti popolazioni). I primi impianti di prevenzione sono stati installati a Terni nel gennaio 2014 e a Perugia nel luglio 2014, attualmente ne sono in funzione cinque di cui tre a Terni e due a Perugia. I primi mesi sono serviti alla messa a punto e regolazione del sistema (integrazione delle varie componenti elettroniche, acquisizione schede di trasmissione dati, miglioramento dei sistemi di alimentazione e di ricarica delle batterie, scelta e disposizione dei sensori). Negli stessi siti, in contemporanea è stato effettuato il monitoraggio tramite fototrappole degli animali che si avvicinano alla carreggiata, utilizzando sia fotografie che filmati, con risultati molto interessanti anche con i dispositivi non completamente implementati. In Provincia di Perugia, nel sito di Costacciaro (SR 3, km 204+700), fra il luglio ed il novembre 2014 (mentre la trasmissione dati non era attiva per mancanza della scheda dati), sono stati registrati almeno 200 scatti fotografici riferiti a 8 taxa di meso e macro mammiferi. I media, nel 19% dei casi, gli animali tornano sui propri passi nel giro di pochi minuti dal primo scatto (il cinghiale, specie più contattata con il 40% degli scatti, torna indietro nel 17% dei casi; l'istrice, 23% degli scatti, 35% dei ritorni) con una modalità mai rilevata in precedenza in nessun altro sito di fototrappolamento. Nonostante l'assenza dei messaggi della centralina che confermino la contemporanea rilevazione di auto in transito, tale singolare comportamento di ritorno indietro fa pensare all'attivazione della misure di dissuasione. Nello stesso sito, dal marzo al settembre 2015, il confronto dei messaggi della centralina con le foto, permette di individuare almeno 18 passaggi di fauna selvatica (10 di cinghiale e 5 di capriolo) in contemporanea all'attivazione della dissuasione acustica: in 4 occasioni (sempre cinghiali) tornano anche indietro. Il carattere sperimentale del progetto, la tempistica dell'erogazione dei finanziamenti e un grosso imprevisto amministrativo (riordino delle Province) hanno finora rallentato lo sviluppo di alcune azioni, ma dal punto di vista tecnico, i primi risultati hanno già ampiamente dimostrato l'efficacia e l'utilità del sistema.

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Analisi della dieta del lupo *Canis lupus* nel Parco Nazionale dell'Alta Murgia

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La recente occupazione da parte del lupo nel Parco Nazionale dell'Alta Murgia - PNAM (Italia, Puglia) ha sin da subito posto interrogativi sulla reale sostenibilità del territorio alla presenza di nuclei stabili. La scarsa vocazione ambientale determinata dalla presenza di sistemi agro-pastorali (praterie mediterranee e seminativi) con formazioni boschive frammentate, la disponibilità di una sola preda selvatica, il cinghiale, immessa a scopi venatori circa vent'anni fa, si associa alla potenziale conflittualità sociale, dovuta alla spiccata vocazione del territorio all'allevamento ovino, che affonda radici antichissime a partire dal XVI sec. con gli Aragonesi e l'istituzione della Regia dogana delle pecore in Puglia. Sin dalle prime segnalazioni di presenza del lupo, a partire dal 2011 l'Ente Parco ha avviato specifici programmi di ricerca volti sia ad implementare le conoscenze sulla distribuzione e sulla consistenza numerica della specie, confermando la presenza di nuclei riproduttivi, sia alla diffusione di buone pratiche utili a mitigare i danni agli allevamenti. Lo scopo di questo lavoro è stato quello di comprendere il regime alimentare del lupo e valutare l'effettivo impatto che la specie esercita sulla componente domestica. La dieta è stata descritta attraverso l'analisi di materiale biologico campionato su 11 transetti dalla lunghezza complessiva di 41.9 km (lunghezza media di 3.8 km; min 2.7 km – max 7.3 km). Ogni transetto è stato percorso a piedi una volta a settimana per tre settimane consecutive tra dicembre 2013 e giugno 2014. Il contenuto dei campioni fecali è stato analizzato utilizzando le procedure standard di laboratorio. La determinazione delle categorie alimentari (categorie animali) è stata effettuata analizzando l'aspetto macroscopico e microscopico dei peli confrontandoli con materiale di riferimento e mediante l'uso di atlanti specifici. Per ciascuna categoria rivenuta è stato determinando il peso e il volume percentuale. Per verificare l'adeguatezza del campione è stato calcolato l'indice di Brillouin (Hb) dei campioni ricampionati 1000 volte con il metodo bootstrap determinando la media degli indici ottenuti e valutando il grado di variazione, in termini di incremento percentuale (I%), tra un campione e il successivo. Sul totale dei campioni sono stati calcolati per le singole categorie trofiche la frequenza di comparsa percentuale (FC%), il volume medio percentuale (Vm%) e la biomassa percentuale (BIO%) ed è stata valutata l'ampiezza trofica della dieta utilizzando l'indice di Levins (B). È stata, inoltre, calcolata la selezione delle specie predate in riferimento alla disponibilità delle stesse utilizzando l'indice α di Manly (α). La disponibilità degli ovicaprini è stata determinata utilizzando i dati catastali dell'A.s.l. regionale (19084 capi) e per il cinghiale sono stati considerate le stime di densità ottenute dai censimenti effettuati dal personale del Dipartimento di Biologia dell'Università degli Studi di Bari nel 2014 (popolazione stimata 3204 individui; densità=29 indiv./ km^2; min 2.6/km^2 – max 217/km^2). Il numero totale del campione analizzato, pari a 43, è stato sufficientemente ampio per descrivere efficacemente il comportamento alimentare del lupo nel PNAM (I% di Hb<1% = n 38) e le 4 categorie trofiche rinvenute, cinghiale (C), ovicaprini (OC), elementi vegetali (EV) e altro (A), sono utilizzate in maniera uniforme (B=0.8). Considerando la frequenza di comparsa percentuale, il valore della categoria degli ovicaprini è risultato doppio rispetto al cinghiale (FCOC65% *vs.* FCC28%), così come sono stati maggiori i valori del volume medio percentuale e della biomassa percentuale (VmOC57% *vs.* VmC21%; BIOOC63% *vs.* BIOC37%), indicandone l'importanza in termini energetici. Tuttavia, la selezione indica come la componente domestica sia stata sottoutilizzata (α=0.28 < 1/m=0.40) rispetto al sovrautilizzo del cinghiale (α=0.72 > 1/m=0.40). I risultati ottenuti suggeriscono ancora una volta l'elevata ampiezza trofica del lupo in cui la componente ovicaprina riveste un ruolo importante nel regime alimentare; viceversa, se si considera la disponibilità delle categorie alimentari (ovicaprini e cinghiali), il lupo sembra selezionare il cinghiale. In termini di selezione, l'utilizzo degli ovicaprini è limitato rispetto alla loro disponibilità poiché con molta probabilità una parte di essi è poco accessibile, pertanto l'adozione di misure di prevenzione adeguate da parte delle aziende zootecniche, soprattutto nelle aree di maggiore frequentazione da parte del lupo (p.es. *rendez-vous*), indurrebbe il predatore ad utilizzare con maggiore frequenza il cinghiale.

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Bat fauna research in the Mount Soratte Natural Reserve (Latium, Central Italy)

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Mount Soratte, 691 m a.s.l., is an isolated limestone ridge in Latium, located c. 45 km north to Rome and the sole notable ridge in the Tiber Valley. It is part of a 444 ha Natural Reserve characterized by numerous natural caves and pits. Our researches, started in 2014, had the aims to investigate the bat diversity in relation to spatial, habitat and seasonal distribution, using these methods: ultrasound detection transects, inspections of summer and winters shelters (underground sites, caves, old buildings, older or dead trees), bones analysis of barn and tawny owl pellets. As a result, 17 bat species were recorded, with 8 of them noted in this area at the first time: *Rhinolophus euryale*, *Myotis emarginatus*, *Eptesicus serotinus*, *Nyctalus noctula*, *Nyctalus leisleri*, *Pipistrellus pipistrellus*, *P. pygmaeus* and *Tadarida teniotis*. The caves and other underground sites explored in the study period are the hibernation places for *R. hipposideros*, *R. ferrumequinum*, *M. myotis/blythii*, *Eptesiscus serotinus* and *Miniopterus schreibersii*. In summer period, the N-E deciduous forests represent an important foraging area for 11 syntopic species: 5 recorded in the forest interior: *Rhinolophus ferrumequinum*, *R. hipposideros*, *R. euryale*, *Pipistrellus pipistrellus*, *P. pygmaeum*, and 6 at the forest edge: *Myotis bechsteinii*, *Eptesicus serotinus*, *Nyctalus noctula*, *N. leisleri*, *Miniopterus schreibersii* and *Tadarida teniotis*.

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Il progetto Allupo – Dall'allevamento ovino alla conservazione del lupo

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Il progetto denominato "Allupo", dall'unione delle due parole Allevamento e Lupo, ideato dal Centro Ricerche per la Biodiversità, in partenariato con il Dipartimento di Biologia dell'Università degli Studi di Bari e la società agricola Masseria Tre Fratelli Corte Cicero, finanziato da Fondazione con il Sud e cofinanziato dall'Ente Parco Nazionale dell'Alta Murgia, nasce dalla necessità di recuperare le praterie mediterranee (habitat prioritario, Direttiva Habitat 92/43 CEE) abbandonate e degradate, e di mitigare il conflitto tra attività zootecniche e il lupo nell'area Parco.

Si intende istituire una Stazione Biologica - Centro di Documentazione per il Lupo, struttura di supporto al Servizio Tecnico dell'Ente Parco, che attraverso un'attività pastorale condotta in sinergia con l'azienda agricola, alleverà razze ovine autoctone in via di estinzione, la pecora Gentile di Puglia e l'Altamurana. Lo scopo del progetto è quello di studiare e monitorare sia le interazioni tra le diverse modalità di pascolamento e le comunità biologiche, che di sperimentare differenti metodi di prevenzione delle predazioni da parte del lupo al patrimonio zootecnico. Le attività di allevamento, nonché le modalità di conduzione sperimentate, porteranno all'elaborazione di un Piano di Pascolamento (linee guida) che tenga conto degli equilibri tra razza ovina pascolante, valore agronomico del cotico erboso, carico, tempi di pascolamento, etc., unitamente all'individuazione di strategie di prevenzione opportune, che potranno essere adottate da altre aziende a livello locale e regionale. Inoltre, gli ovini in allevamento assumeranno la duplice funzione di essere "utilizzati" come Gregge del Parco, per la sostituzione dei capi predati dal lupo, e come fonte di reddito per finanziare parte del monitoraggio del lupo – *la pecora aiuta i lupi* – e le attività di formazione, garantendo così continuità all'analisi dello *status* del lupo e alla diffusione delle buone pratiche pastorali che vedranno coniugare le produzioni con la conservazione della biodiversità.

Il lupo diventa, o ci si auspica che diventi, soprattutto in questo contesto territoriale dove ormai da lungo tempo si è persa la memoria storica, non solo simbolo della conservazione della biodiversità ma anche simbolo e valore aggiunto di quelle produzioni agro-pastorali ottenute da aziende agricole che operano a favore della conservazione dei pascoli e della convivenza con il lupo. Alcuni prodotti quindi, soprattutto se ottenuti da animali poco produttivi, come le razze autoctone, potranno assumere un nuovo valore in funzione di un approccio etico del consumatore che si tradurrebbe in una maggiore attenzione nei confronti delle razze in via di estinzione, con ripercussioni positive sui livelli di conservazione della biodiversità in toto: *il lupo aiuta le pecore*.

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Modelli di utilizzo dello spazio del cinghiale nei sistemi agro-silvo-pastorali del Parco Nazionale dell'Alta Murgia: dati preliminari

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L'espansione della popolazione di cinghiale in Italia negli ultimi decenni ha causato una serie di problematiche soprattutto in agricoltura, e pertanto risulta fondamentale acquisire informazione sull'utilizzo dello spazio e dell'habitat, specialmente in contesti antropizzati.

La diffusione del cinghiale nel Parco Nazionale dell'Alta Murgia è un fenomeno relativamente recente da attribuire sia a eventi di immigrazione che a operazioni di "reintroduzione", avvenute tra il 2000 e il 2002, con circa 170 capi, ad opera dell'ATC della Provincia di Bari.

Il nostro studio intende descrivere (i) l'uso degli agro-ecosistemi da parte del cinghiale in funzione della distanza dai margini delle *patches* boschive e (ii) la selezione dell'habitat al fine di esaminare la sua importanza nel modello di utilizzo dello spazio.

Allo scopo sono stati seguiti 6 animali (5 femmine e 1 maschio juv.) marcati con collari satellitari (Vectronic Aerospace - GPS PRO Light-3 Collar).

Il Parco Nazionale dell'Alta Murgia ha un'estensione di circa 68077 ha, compresi nel SIC/ZPS Murgia Alta, solo 11000 ha sono costituiti da superficie boscata frammentata (rimboschimenti di conifere, boschi di latifoglie), mentre la restante superficie è costituita da praterie mediterranee di interesse comunitario (Direttiva Habitat 43/92 CEE) e altro (seminativi, coltivazione arboree, cave, etc.).

Lo studio viene attualmente condotto all 'interno dei comprensori boschivi di latifoglie delle località di Masserie Nuove (agro di Corato) e di Lama d'Ape-Jatta-Scoparello (agro di Ruvo di Puglia).

I danni alle coltivazioni da parte del cinghiale si concentrano proprio tra i comuni di Ruvo di Puglia e Corato, coinvolgendo soprattutto i mandorleti, gli uliveti e i vigneti. Queste aree, nella località di Masserie Nuove (Corato) e Lama d'Ape (Ruvo di Puglia), sono caratterizzate da elevati valori di densità del cinghiale, rispettivamente con 27 e 55 individui/100 ha (periodo di censimento: febbraio 2015), mostrando una relazione diretta tra la densità dell'ungulato e gli eventi di danneggiamento.

I dati riferiti alle posizioni degli animali marcati durante l'attività di alimentazione si riferiscono al periodo compreso tra il 18 novembre 2014 e il 31 gennaio 2016, per un totale di 6147 localizzazioni.

Per l'analisi dell'uso degli agro-ecosistemi in funzione della loro distanza dal bosco sono stati utilizzati i *fix* degli animali all'interno di ciascun *home range* (MPC 100%) confrontati con un ugual numero di *fix* casuali creati in ambiente GIS. Se il cinghiale si alimenta in alcuni settori senza tener conto della distanza dal margine boschivo, potrebbero non esserci differenze significative tra i *fix* "reali" e quelli randomizzati. L'uso dei punti *random* è stato utilizzato al fine di testare l'ipotesi secondo la quale il cinghiale utilizza quei settori prossimi al margine del bosco.

La selezione dell'habitat è stata analizzata considerando le localizzazioni in relazione alla disponibilità, attraverso il calcolo degli intervalli fiduciali di Bonferroni.

Comparando e confrontando i *fix* e le loro distanze dal bosco, i risultati confermano come l'uso delle porzioni all'interno degli agro-ecosistemi da parte del cinghiale è in funzione della distanza dal margine del bosco (media *fix* "reali" 508 m dal margine *vs. fix random* 3096 m; M-W U-test, $p<0.001$).

Il cinghiale mostra un utilizzo dell'habitat in maniera differente rispetto alla disponibilità (test del chi-quadro, $p<0.001$), selezionando il bosco di roverella, le praterie e gli uliveti.

I risultati del nostro lavoro confermano come gli agro-ecosistemi in prossimità del bosco sono i più utilizzati; la distanza dal margine del bosco è un fattore che influenza e descrive i modelli di utilizzo dello spazio da parte del cinghiale, sottolineando inoltre, come il bosco di roverella sia fondamentale per la specie.

Quanto ottenuto, unitamente a successive analisi che andranno a descrivere l'uso e la selezione dell'habitat su scala temporale/stagionale, potrà essere utile ad ottimizzare le azioni gestionali già individuate e intraprese dall'Ente Parco.

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Camera trapping of weasel family (Mustelidae) and wildcat - *Felis silvestris* - in the Dolomiti Bellunesi National Park: a three-year survey

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The Natural History Museum of Venice had been assigned to conduct a camera trapping survey within the project "Monitoring the biodiversity in the alpine environment", which was carried out by the Dolomiti Bellunesi National Park with the financing of the Ministry of Environment. The aim of the survey has been to expand the knowledge about the presence and the distribution of weasel family (Mustelidae), as well as to determine the presence of the wildcat, *Felis silvestris* Schreber, 1977. This survey was been conducted for three years, from 2013 to 2015, and it overall interested twelve study areas, which have been chosen among the protected area according to environmental suitability, geographic position, accessibility, absence of historical data and also verification of the data we obtained during the study. The camera trapping stations, whose number was determined by the extension of the study areas, were placed on attraction sites. The information obtained during the three-year survey has allowed to complement the limited, fragmented knowledge about the distribution of weasel family in the Park, as well as to ascertain the presence of the wildcat for two consecutive years in the same areas. This data, together with other recent reportings beyond the borders of the protected area, is supposed to confirm the spread of the wildcat's population towards North-West as well as the possible presence of a resident population in the Dolomiti Bellunesi National Park. This data is therefore going to open new hypothesis about the status and the distribution of this most interesting carnivorous in Belluno province.

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Multidisciplinary approach in monitoring Geoffroy's bat (*Myotis emarginatus*) in an agriculture-dominated landscape (River Ticino Valley)

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River Ticino Valley is a green tongue through the Po Plain surrounded by a vast agricultural landscape, that hosts one of the biggest Geoffroy's bat (*Myotis emarginatus*) nursery in Europe. The definition and implementation of conservation measures for the species, listed in the Annexes II and IV of the Habitat Directive, are compulsory.

We evaluated flight directions and land use (by Ivlev Index Test) of the nursery by radio tracking 8 females during summer 2015. We estimated the presence of approximately 3000 bats, and all animals leaving the roost followed a well-defined path along buildings, hedges and rows, heading west toward the forest along Ticino river, with a maximum distance at which an animal was observed of 7.48 km away from roost. Due to the restricted number of locations for each bat, we considered as home range the extension of the area covered by all locations from all tagged animals. Estimation of the home range was made using h_{ref} KDE with different probability density level. 95% h_{ref} KDE home range extension was 11248 ha, while 55% h_{ref} KDE home range extension was 2609 ha. In both cases Ivlev Index indicated that woodlands surrounding Ticino riverbed were favourite foraging habitats.

Emergence from roost was weekly recorded with IR camera to investigate differences in bats flight timing from May to late August, and bioacoustics survey was carried out from July to September 2014 to detect the presence of bats in different habitats.

We lastly analysed bat guano by collecting pellets under the colony on a weekly basis, from early May to mid July, in order to: (1) determine the trophic niche of the nursery; (2) obtain information about the foraging areas of the animals; (3) measure the presence of banned persistent pollutants in the guano.

Araneida made up the main part of bat diet ($freq_{occ}$=0.92%; vol_{tot}=50.34%), followed by Homoptera (Cercopidae) ($freq_{occ}$=0.52; vol_{tot}=32.61%) and Coleopthera ($freq_{occ}$=0.34; vol_{tot}=9.53%). Large variations in diet composition were observed in June, with a reversal in the proportion of Homoptera (vol_{tot}=52.8% in June and 23.9% in other periods), which made up the most of the diet, and Araneida (vol_{tot}=27.3% in June and 60.2% in other periods).

The concentration of organic persistent pollutants in bat guano was low (DDT=6.34÷10.21 ng/g p.s.; PCB=33.77÷43.67 ng/g p.s.), indicating the persistence of a diffused contamination of banned substances in the area. These low concentrations suggest that the trophic resources exploited by bats were not significantly affected by persistent pollutant, maybe also thanking to the presence of a big biodynamic farm near the colony, but highlight the need of a specific monitoring scheme that can show the bioaccumulation of new pollutants that will be used in agriculture.

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Bat nursery dynamics in the Alps: how can microclimate affect bats conservation?

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Studying population dynamics of species facing threats due to climate change, and their response to micro and macro-climatic conditions is mandatory to better understand how they will respond to future climatic conditions. This is especially true for rare and threatened species that live in ecosystems and environments that will possibly undergo major changes, like those in the Alpine area.

During 2015 we studied the dynamics of 8 bat nurseries of 7 different species, 5 of which listed in the Annex II of the Habitat Directive (*Myotis myotis*, *M. blythii*, *M. emarginatus*, *M. nattereri*, *M. brandtii*, *Rhinolophus ferrumequinum*, *R. hipposideros*), in Stelvio National Park (Eastern Alps). We carried out monthly bat counts from April to October, using a camera for counts inside the roosts and using the "Android Advanced tally count" application for portable devices for counts at emergence from roosts. During the reproductive period, we counted the newborns inside the nurseries after the adults flown away to forage. We recorded hourly temperature inside and outside the roosts during the same period with iButton data loggers.

Animals started to occupy the roosts in April and reached their maximum in July, when most bats gave birth (with the exception of *Myotis myotis* and *M. blythii* who gave birth in June): from August, animals started to leave the roosts and by September half of them were empty, while in the other half only a few bats were still remaining in October. In four of the roosts we found a positive correlation between bats number and roost mean temperature: the hottest month was July, peaking at nearly 40 °C inside the roost, more than 5 °C higher than outside temperature. Reproductive rate varied between species: the two sibling species *Myotis myotis* and *M. blythii* showed a low reproductive rate (38%) in both sites monitored (2500 and 270 adults respectively), while nearly 54% of *Rhinolophus hipposideros* and 46% of *R. ferrumequinum* females gave birth in the reproductive sites monitored (three for *R. hipposideros* – 110, 162 and 91 adults respectively -– and one for *R. ferrumequinum* with 67 adults).

This study represents a "zero point" for a long-term monitoring scheme that should collect precious information about population dynamics variations due to micro and macro-climatic conditions in the Alps and to help reveal other factors affecting bats conservation.

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Atlas of the bats of Sibillini National Park: current status

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No specific studies of the bat fauna of the Sibillini National Park had been carried out until 2012. We developed a preliminary profile of the presence and distribution of bats within the protected area, initially with the "Presence, distribution and ecological aspects of rare mammals located in the Sibillini National Park" project, followed up by the subsequent "Conservation and management of forest ecosystems" project.

The data collected from these projects was analysed in parallel with what little literature was already available on the subject, and databases and museum collections were consulted, leading to the launch of a further two-year field study phase (2015–2016).

The research is aimed at achieving the following objectives: creating a checklist of bats in the area of the Park; assessing the conservation status of different species; preparing management guidelines; and creating a database of the species present.

A map projection of grids of 4 km on each side was overlaid onto UTM grid zone reference 33T, using Quantum GIS Version 2.10.1 open source software. Taking where the grid zone intersects with the territory of the Park, we excluded cells comprising a protected area surface of less than 5% of the total extension area of the single cell, and thus defined a total of 60×4 km^2 reference cells.

A digital terrain model was then superimposed, with the aim of excluding territory with altitudes greater than 2000 m above sea level.

The research is conducted through the application of a variety of detection techniques, including bio-acoustic surveys, the detection and inspection of potential roosts, and the capture of individuals using mist nets and harp traps.

For the bio-acoustic survey, readings, each lasting 10 minutes, are taken from fixed sensing devices. In order to ensure adequate and homogeneous coverage of the territory, two fixed bio-acoustic sensing devices are set up in cells comprising at least 50% of effective surface area, while one sensing device is set up in cells comprising an effective surface area of less than 50%. This makes for a total of 99 bio-acoustic sensing device readings.

The identification of potential roosts within the 60 cells is carried out in consultation with the Umbria and Marche regions Speleological Registry, using maps and consulting with local cavers, as well as via direct field research.

Similarly, trapping sites within the 60 cells are chosen opportunistically, with the help of mapping and direct research in the field.

Based on the data collected so far, the preliminary checklist of bat fauna in the Sibillini National Park includes 11 species: *Rhinolophus ferrumequinum*, *Rhinolophus hipposideros*, *Rhinolophus euryale*, *Myotis emarginatus*, *Myotis nattereri*, *Pipistrellus pipistrellus*, *Pipistrellus kuhlii*, *Hypsugo savii*, *Nyctalus leisleri*, *Miniopterus schreibersii* and *Tadarida teniotis*.

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The bats of the disused Spoleto to Norcia railway line: a model example of the integration of Umbria's natural and cultural heritage

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The Spoleto-Norcia railway line was inaugurated in 1926 and decommissioned in 1968. Its design peculiarities as a mountain railway make it one of Italy's most prestigious examples of railway engineering. The 51 km route runs through the towns of Spoleto, Santa Anatolia di Narco, Vallo di Nera, Cerreto di Spoleto and Norcia, in the province of Perugia in the region of Umbria.

Following closure various restoration projects were implemented, ensuring track safety and allowing the line to be put to other uses, both currently and moving into the future.

The historical and cultural value of the track goes beyond its contribution to the local landscape: the particular circumstances of the current status of the railway line have had a profound effect on the local fauna. The route includes approximately 5 km of tunnels, and these provide roosting opportunities for several species that are of great interest from a conservation point of view.

The Caprareccia Tunnel is of particular interest. It is located along the first stretch of the former railway line, between Spoleto and Santa Anatolia di Narco.

The tunnel is home to an important wintering colony of *Miniopterus schreibersii*, the largest known colony in Umbria, as well as a colony of *Rhinolophus ferrumequinum*. The same stretch of tunnel is also noted for the presence of a few isolated individuals of *Myotis myotis*, *Myotis blythii*, *Pipistrellus* sp., and *Barbastella barbastellus*.

The *Miniopterus schreibersii* colony has roosted in the central stretch of the tunnel for more than 10 years, and has been subject to monitoring since 2006.

Over time, the size of the colony has gradually increased, rising from 923 individuals counted in 2006 to 4284 in 2016. There was a modest contraction in 2007, likely due to the disruption of the tunnel consolidation work that was being carried out at the time.

This continued presence provides a clear demonstration of the significant impact particular constructions can have on bat conservation due to their specific characteristics and their suitable microclimate — particularly in the cases of some specific species. Today, this tunnel is the most significant *Miniopterus schreibersii* site in the region of Umbria.

The valuable contribution that the site represents for bat conservation cannot, however, be taken for granted: consolidation work to ensure the safety of the tunnel, its adaptation for pedestrian, cycling, and horse riding use, unsupervised human access, and construction work on the land above can all significantly alter the site's specific environmental conditions, potentially affecting the integrity of the colony irreversibly.

We must first endeavour to inform the public and institutions how these sites, already recognised and valued as wonderful feats of engineering of great historical and cultural interest, can at the same time also be places of inestimable value to wildlife. By ensuring appropriately regulated use of the sites, where possible accompanied by projects and activities to teach visitors about this extraordinary phenomenon and celebrate it, the sites can be conserved, and this unique regional and national wildlife heritage can be put to sustainable use, potentially raising funds and providing local employment opportunities.

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Acoustic monitoring of golden jackal (*Canis aureus*) in different habitats of Srem, Serbia

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The main objective of this study was to estimate density of golden jackal population in four different habitat types of Srem region, Serbia. In this purpose acoustic method was performed across four different transects: two along rivers - Danube and Sava, one across Fruška Gora mountain and one across croplands in central part of Srem region. In this abstract, preliminary results of our research are presented.

The acoustic study was performed between October 24th, 2015 and December 15th, 2015. In this period, the method was performed for 10 nights. In total, 55 hours were spent on the field. The weather was usually suitable for field work: temperature was between 0 °C and +8 °C and there was no wind. Some nights were foggy and that reduced the possibility to perform additional visual observation.

The Danube transect is placed northernmost. The Fruška Gora transect is placed along the ridge of Fruška Gora mountain; it's a 42 km long forest habitat and it is representing the shortest transect. The central Srem transect is along agriculture fields. The longest (171 km) and southernmost placed transect is along Sava river, characterized by riparian forests.

In these four transects a total of 155 calling stations were settled: 35 stations along the Danube transect, 20 stations along the Fruška Gora transect, 28 stations along the central Srem transect and 72 stations along the Sava transect. Distance between successive trial calling stations was between 2 and 4 kilometers, depending on topography. Every calling station covers a circular area of 3.14 km^2 (radius of 1 km). In total, all of the 155 calling stations covered an area of 487 km^2, which represent 14% of Srem region (that is 3486 km^2).

In every calling station a group-yip howl and a single howl were alternately played. The recorded jackal howl was played for 30 seconds, followed by a 5 minutes pause to wait for an eventual response. This set of broadcast and pause was repeated 3 times in each calling station. The assumption is that only territorial groups answer; a group is counted as 4 specimens. For all responses, direction was determined with a compass. In order to avoid double counting, all responses from nearby calling stations were checked with triangulation. Also spontaneous howling was counted as a response. During field work only a single specimen was recorded as spontaneous howling.

Acoustic monitoring was combined with visual observation. After the end of yip howls the area around the calling station was lighted with intense spotlights in order to count eventual approaching animals. In total, 6 single specimens were observed in this way.

Along Danube transect 5 responses (14.3%) were registered, 4 responses (20%) in the Fruška Gora transect, 10 responses (35.7%) in the central Srem transect and 30 responses (45.8%) in the Sava transect. In total, there were 49 responses in 155 calling stations (31.6% of answering). Of those 49 responses, 24 were from a single specimen, 4 were from a pair and 21 were from group of jackals. The population density of golden jackals was 2.5 specimens/10 km^2. The minimal possible population number of golden jackals in Srem region was estimate as 872 individuals.

Of all four transects, the most suitable for golden jackals seems to be the riparian habitat along Sava river. In this habitat the major number of specimens and territorial groups were recorded. The population density of golden jackals in this transect is 3.6 specimens/10 km^2. Both Danube transect and Sava transect are settled along rivers, but there are more specimens in the last one. This can be explained because along the Danube there are a lot of holiday houses and immediately in the South there is Fruška Gora mountain, that maybe is not the best habitat for jackals.

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A field experiment to evaluating wild boar impact on forest regeneration in the northern Apennines (Italy)

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Forest regeneration is subject to the impacts of ungulates herbivores and seedling predators. Exclusively deer and bovid species do not compose ungulates communities, which play a key role on plant regeneration with their browsing activities, but also by wild boars (*Sus scrofa* L.), whose occurrence is increasing in the last decades, especially in the mountain areas of the Apennines. Several studies on the ungulate impacts on forest regeneration were carried out by means of field enclosure approaches. However, these methods excluded every species and, consequently, did not show the impact of a particular species. The most widespread forest habitats in the northern Apennines are those dominated by Turkey oak (*Quercus cerris* L.), chestnut (*Castanea sativa* Mill.) and beech (*Fagus sylvatica* L.). The fruits of these species represent an important proportion in the diet of wild boar; moreover, fruit predation by wild boar on this species may condition the regeneration process more than other ungulates species. To evaluate boar impact on forest regeneration, we tested a new method that prevents fruit predation and seedling damages without excluding all the other species. We used an electro-welded iron square grid of 1×1 m with a 10×10 cm mesh size. This grid was placed 10 cm above ground, so that the wild boar nose could not reach the fruits or resources under the gird. However, the size of the mesh have allowed other wildlife species (i.e. roe deer, squirrel, birds etc.) to take resources even under the grid. As matter of fact during camera trap sessions we recorded also other species, particularly roe deer, some birds, squirrel, badger, and crested porcupine. All these species searched for food under the grid. We considered the space under the grid as "sample area", whereas the "control area" was a space with equal size of sample areas, completely access free and adjacent to the sample grid, so that fruits could fall in sample or control area with the same possibility. We have chosen sampling sites selecting the woods of chestnut, Turkey oak, and beech by land use digital layer of Massa-Carrara province, and creating randomly selected points within the woodlands. The points have been created using the tool "create random point" software ArcMap 9.2 (ESRI). In this way, we identified 20 points for each woodland type, 60 points in total, where we placed the iron grid electro–welded and the corresponding control area. We tested the efficiency of the iron grids for their real selective function against wild boar foraging activity using camera trap mod. SG 560D in at least 5 points for each species. The camera traps were placed on trees close to the iron grids in order to shoot wild boars in foraging activity and understand their behavior above grids. The camera traps were set up on video mode, with a duration of 1 minute for video and a PIR interval of 5 minutes. Each video output has been analyzed collecting data on the number of present boars and their class of sex and age (when possible), in order to define the group size and type. Adult males, adult females, and groups represented the group types with adults and piglets. Moreover, we recorded the time spent by each individual on the gird when tried to reach the food resources and the success of such attempts. The statistical analyses supported our hypothesis that wild boar spent less time on areas with grids than on areas without grids, precisely 14.3% of time (recording seconds) was over the grid, while 85.7% of time was over the control area. Moreover, the time spent over the grid was inversely correlated with the group size (Regression model: R^2=0.107; F=4.672; p=0.037) and with the group type (Regression model: R^2=0.184; F=8.818; p=0.005). The correlation with group type was explained also by the high probability of presence of piglets in the more numerous groups. The grid was an effective deterrent for the wild boar and allowed us to analyze the impact of wild boar comparing the fruits and plants occurring in the area below the grid with those occurring in the control area.

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Lagomorph's parasites in Alpine areas

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Wild lagomorphs are valuable species from a conservative and economic point of view. The main species present in North Western Italy are the European brown hare (*Lepus europaeus*) and the Mountain hare (*Lepus timidus varronis*). The European brown hare population suffered strong decline since the 1960 due to hunting activity, environmental changes and infectious diseases (in particular the European Hare Brown Syndrome). In the last years a jeopardizing increase of hare numbers in some lowland areas was observed. In the Alpine area, although, the decline still continue. No information are available for the population dynamic of Mountain hare. In this contest it would be useful to have information about the diseases that can affect the fitness of these species. Parasitic diseases in particular can have a strong effect on population dynamics of wildlife. This kind of studies are available for lagomorphs populations in lowland areas, but not many data are reported for the mountain areas.
The objective of this study is to increase the knowledge of parasitic diseases affecting *L. europaeus* and *L. timidus varronis* in mountain areas. To this purpose the gastrointestinal pack of 60 animals (10 *L. timidus varronis* and 50 *L. europaeus*) were analysed.
The specimens were collected during hunting season by local hunters. From fresh carcasses the whole gut was frozen at -20 °C until the analysis. Standard laboratory techniques were used to recover, collect, store the parasites. Parasites were identified by using a morphometric approach and through the use of dichotomous keys.
The main results regarding the species of parasites observed, their prevalence and abundance are discussed and compared with the scientific literature available.

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Origin, population size and genetic status of feral donkeys in the Asinara island, Sardinia

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The Asinara white donkey (*Equus asinus*) is the iconic animal of the Asinara National Park, which was established in the Asinara island, north-west of Sardinia, in 1997 after the disposal of the penitentiary.

The white (albino) donkey co-occur in the island with grey donkeys (resembling the Sardinian donkey breed), as well as with a range of wild and feral animals mostly introduced by humans in different epochs.

The history of the donkey population and the relationships between the two morphotypes were unclear. In 2015 a project was started to assess the population size and genetic make-up of the population.

Line transects were replicated in June and November to estimate the number of donkeys in the island, recording sex, age class, coat colour, group size and group composition.

Blood samples were collected by live-capturing animals by simple confinement, in case of confident individuals, or by tele-anaesthesia, in case of elusive individuals.

Genetic analyses involved partial sequencing of the D-loop region of the mitochondrial DNA (mtDNA) and genotyping of 18 polymorphic microsatellites.

Census activity provided an estimate of around 350 donkeys, 120 of which were albino. Donkeys are ubiquitous, but a marked segregation of the two morphotypes exists: white donkeys are strongly prevalent in the south whereas grey donkeys prevail in the north of the island.

MtDNA sequences, compared with a comprehensive sample of several hundred GenBank sequences, including Eurasian and African breeds, plus ancient, historical and living wild ass (*Equus africanus*).

A phylogenetic analysis on the obtained D-loop sequence alignment proved the close relationship with domestic donkeys inhabiting the main island and ascribed to the Sardinian breed.

Genetic characterization revealed that white and grey donkeys in the island have a common origin and should be considered part of a single population with a shared gene pool, though a genetic structure was observed, favoured by the elongated and sinuous shape of the island.

The achieved data clearly deny several contrasting anecdotic hypotheses on the origin of the white Asinara donkeys and represent a contribution to the management of this species in the National Park.

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Fototrappolamento nel Parco Nazionale Foreste Casentinesi Monte Falterona Campigna: progetto su Carnivori di interesse conservazionistico

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Nel 2012 è stata avviata una collaborazione tra il Parco e l'Università degli Studi di Perugia per lo "Studio su Carnivori di interesse conservazionistico e gestionale nel Parco" avente come specie-*target Martes martes*, sulla cui presenza nell'area protetta non si disponeva di dati scientifici attuali e oggettivi, su *Felis silvestris silvestris* e *Mustela putorius*, per le quali si volevano ottenere maggiori informazioni. Nei primi due anni di ricerca sono stati utilizzati il Metodo Naturalistico e Genetico grazie ai quali sono stati riscontrati 4 Indici di Presenza appartenenti a martora. In questo modo il primo risultato importante è stato raggiunto: *Martes martes* "torna" a fare parte della fauna del Parco dopo 16 anni dall'ultimo reperto oggettivo. Durante il terzo anno di studio il gruppo di lavoro ha voluto associare una terza metodica, il Fototrappolamento. Per questo motivo sono stati individuati 5 transetti di campionamento, coincidenti con le *linetrap*, lungo i quali sono stati messi in atto i tre Metodi di studio e sono state collocate 6 coppie di dispositivi di fotocattura (Ltl Acorn 5210 e Cuddeback Ambush), ad un intervallo medio di 600 metri per uno sviluppo totale di circa 3 chilometri lineari per ogni transetto. Le aree di saggio sono state posizionate tutte nella porzione Nord-Ovest del Parco, dove ricadevano i precedenti indici di presenza della martora. Il programma di fototrappolamento si è svolto da settembre 2014 a giugno 2015 per un totale di 2664 notti/trappola ripartite in 5 sessioni di campionamento: due *linetrap*, A e Abis, nella Valle del Tramazzo (396 notti/trappola per la prima e 626 per la seconda), una *linetrap* B per il Valico dei Tre Faggi (432 notti/trappola), una *linetrap* C al Passo della Calla (372 notti/trappola) e una *linetrap* D alla Grotta delle fate (838 notti/trappola) nei pressi di Castagno d'Andrea. Solo in quest'ultima area è stato utilizzato un attrattore olfattivo, la tintura madre di valeriana. In 9 mesi di ricerca sono stati ottenuti 59,819 reperti tra foto e video che comprendono uomini (escursionisti, ciclisti, operai, automezzi…), scatti a vuoto per cause naturali (forte vento, pioggia, neve…) e una ampia lista di fauna selvatica tra cui le tre specie *target*: 45 catture di *Felis silvestris silvestris*, 39 di *Mustela putorius* e 4 di *Martes martes*. La presenza della martora è stata quindi confermata anche dal fototrappolamento con due reperti nella Valle del Tramazzo e due nella Grotta delle fate. Nelle stesse due aree risulta presente anche la puzzola, con una abbondanza maggiore presso la Grotta delle fate. Al contrario, il gatto selvatico è l'unica specie target che è stata catturata in tutte le *linetrap* indagate. Per quanto riguarda i Mustelidi si aggiungono anche 38 catture di *Martes foina*, 7 reperti attribuiti al genere *Martes* e 2 fotocatture di *Mustela nivalis*, mentre per i Felidi si registrano anche 5 reperti attribuibili ad individui ibridi (*Felis silvestris silvestris* × *catus*) e 8 a gatti domestici. Questi ultimi sono stati riscontrati solo nella linetrap D, probabilmente perché è la più vicina ad un centro abitato e/o perché è stata utilizzata la tintura di valeriana. La specie con Indice di Cattura Specifico (ICS=numero totale di scatti attribuiti ad una specie / sforzo di campionamento) più elevato è il gatto selvatico (1.69), seguito dalla puzzola (1.46) e dalla faina (1.43). La martora presenta un valore ICS di 0.15, quindi molto più basso rispetto agli altri mustelidi presenti nel Parco. In conclusione si può affermare che: 1) *Felis silvestris silvestris* mostra una presenza costante e ben distribuita nell'area Parco, ma presenta un, seppur minimo, grado di ibridazione a cui è estremamente importante porre attenzione al fine di non compromettere la conservazione della sottospecie; 2) *Mustela putorius* dimostra ancora una volta il suo forte legame con determinati ambienti, infatti solo in questi è stata rilevata con valori di abbondanza elevati; 3) *Martes martes* nonostante risulti ancora estremamente rara, ha registrato una presenza constante nei tre anni di lavoro, tuttavia la sua sporadicità la rende fortemente vulnerabile e pertanto è auspicabile un ulteriore approfondimento e un suo costante monitoraggio.

Hanno collaborato per l'intera durata del progetto, raccogliendo dati sul campo e/o rendendo disponibili quelli in loro possesso: CTA – CFS del Parco, UTB – CFS di Pratovecchio, Stazione CFS San Benedetto in Alpe e di castagno d'Andrea, Associazione Amici del Parco, Marco Lucchesi, Paola Fazzi, Enrico Schifano, Giancarlo Tedaldi, Claudio Bertarelli, Sara Lefosse, Danio Miserocchi, Marco Magrini. Un particolare ringraziamento a Francesco Lemma per il supporto logistico e tecnico.

X Congresso Italiano di Teriologia

Wild-living cervids lactation: analysis of metabolic parameters in kid and in milk of adult females in relation to wildlife management

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Wildlife management needs a continue comparison between actions, derived from rules, guidelines and local codes, and data resulting at the end of each hunting season. For this purpose, it is necessary to contribute to the planning management, not only with population dynamic and distribution data, but also with information about animal welfare and physiological condition of subjects. So, biological aspects need to be completed with animal science and veterinary research, that may provide additional discussion on wildlife management in relation to the environment occupied by the species.

In particular, in this work we report data concerning two different wildlife methods for red deer (*Cervus elaphus*) conservation used in different years in the so called Comprensorio Alpino di Caccia VCO2 - Ossola Nord, located in Verbania province in Lepontine Alps. In this hunting district, rules have always provided a financial penalty for the hunter who culled a nursing female (except for 2004/05 hunting season) in order to protect this category. In fact, in order to facilitate the culling of dry females, period of adults culling was different to that of young subjects. It derived that the mean value of nursing females culling was 40% with these rules. In 2013 ISPRA issued The Guidelines for Ungulates Management that provide deer hunting between 15th October and 15th December. This temporal shift has consequently increased the mean value of nursing females culling to values higher than 55% (with a maximum value of 63% in 2013/14 hunting season).

Starting from metabolic parameters analysis, the mean values of cholesterol in serum are significantly higher in kids than other age classes (mean$\pm$Std Dv): Kids: 74.30$\pm$17.62 mg/dl (C.I. 95% 66.05–82.54 mg/dl); Adult females: 52.18$\pm$13.15 mg/dl (C.I. 95% 47.80–56.57 mg/dl); Adult males: 38.45$\pm$17.19 mg/dl (C.I. 95% 30.40–46.49 mg/dl). It is clear that the mean value of cholesterol in kids depends exclusively on the assumption of maternal milk that, even in autumn, has high energy and nutritional values.

Moreover, during November and December 2013, mammary glands of nursing females have been collected, weighted, and milked for chemical analysis on milk. Results showed that mean weight of lactating mammary glands was 660 g (657.67 g in 2/3-year-old females, 693.93 g in 4/6-year-old females, 636.67 g 7/9-year-old females). This result is in marked contrast to the weight of the mammary gland collected from a dry 4/6-year-old female, amounting to only 85 g, and confirms that the mammary glands of nursing females are active and productive in November/December too.

Enough milk (about 20 ml) has been collected from nine females for further processing to detect values of lactose, fat and protein. A part of these samples has been cooled at +4 °C soon after the collection and analysed by infrared method (FIL IDF 141C:2000) at IZS of Torino. Milk samples have been diluted 1:2 because of the high fat content. The other milk samples have been analysed at the University of Parma: protein fractions were determined by the Kjeldahl method, Ca and Mg by atomic absorption spectroscopy and P by the colorimetric method.

Fat and protein values in red deer milk showed higher variability than lactose. There were differences among milk parameters related to age classes. A significant correlation was found between the mammary gland weight milk proteins content.

The following mean values resulted from milk analysis: lactose 4.08 g/100 g, fat 7.82 g/100 g, raw protein 9.24 g/100 g, casein 7.84 g/100 g, P 185.82 mg/100 g, Ca 265.85 mg/100 g, Mg 23.57 mg/100 g.

Concluding, results obtained from 2013 milk samples showed fat and protein values very high, even in females culled in November/December. It suggests that the quality of milk produced during late autumn season is of primary importance for kid diet. For this reason, it is appropriate to ensure greater protection to nursing females, because kid subsistence during winter season in the Alps is strictly related to the possibility to complete the vegetable diet with a food rich in fat and minerals and highly energetic.

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Using a global calibration by near-infrared reflectance spectroscopy (NIRS) to predict faecal nitrogen in herbivores

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Quality of food resources drives most life history traits of animals. In wild herbivores, diet quality can be assessed by faecal indicators that are becoming popular in recent years. The difficulty to estimate the animal intake and digestibility has led to use faecal indicators that indirectly relate chemical compounds from the digestion and diet quality. Among the faecal indicators, faecal nitrogen is the best-known indicator of diet digestibility. Faecal samples to study the diets are widely used, because of the easy collection of droppings without the need of animal capture. Chemical composition of faeces has been traditionally estimated by conventional laboratory techniques, that in turn are time-consuming and expensive. In the last 20 years, however, near infrared reflectance spectroscopy (NIRS) has become a widespread, rapid, low cost, and non-destructive methodology for predicting chemical compounds in faecal samples. To estimate faecal nitrogen content by NIRS, the recommended practice is to develop an initial calibration for each animal species with a minimum of 50–100 faecal samples that have to be validated later by cross-validation or external validation. This protocol increases the accuracy of predictions, but also laboratory costs when the number of target species is large. Also, the sample size is often limiting when working with rare or endangered species. To deal with these limitations, we calibrated a single NIRS equation (i.e., multispecies calibration) to assess the faecal nitrogen content in herbivores. Thanks to our previous experience in developing NIRS faecal nitrogen calibration curves for different species, we observed that the specific equations (i.e., equations for each species) differed in the range of faecal nitrogen values, but not in their slopes. This fact motivated us to derive a single multispecies equation to predict faecal nitrogen of several species of herbivores.

First, we used five herbivore species with contrasting digestion physiology (i.e., horse *Equus ferus*, sheep *Ovis aries*, Pyrenean chamois *Rupicapra pyrenaica*, red deer *Cervus elaphus*, and European rabbit *Oryctolagus cuniculus*), to build a multispecies calibration. Then, we employed other species not included in the multispecies set (i.e. Alpine ibex *Capra ibex*, goat *Capra hircus*, European mouflon *Ovis musimon*, roe deer *Capreolus capreolus*, and cattle *Bos taurus*), to assess the prediction accuracy of our multispecies equation.

On the one hand, we used linear models and the Akaike Information Criterion to explore whether faecal nitrogen was better predicted by the specifics equations or by the global one. On the other hand, we used NIRS standard statistics derived from cross and external validations, to assess the accuracy of NIRS calibrations for predicting faecal nitrogen.

Results obtained for the multispecies calibration equation and validations showed a very good accuracy. The coefficient of determination for calibration (R^2) was 0.98; standard errors of validation were 0.10 for cross validation (SECV), and 0.12 for external validation (SEP); and the ratios of performance to deviation (RPD) and range error of prediction (RER) were 5.3 and 28.4, respectively. The prediction accuracy of the equation applied to the herbivore species initially excluded from the calibration dataset, was only slightly lower. The R^2 was higher than 0.86, SEP was lower than 0.27, and RPD and RER were higher than 2.6 and 8.1, respectively.

In conclusion, it is possible to avoid monospecies calibrations to predict the faecal nitrogen in herbivore species. A multispecies calibration equation can be an accurate and easier tool, even when the faecal samples belong to a wide variety of herbivores.

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Birth, growth and neonatal mortality of Italian roe deer fawns in a Mediterranean population

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The roe deer of Mediterranean habitats in the central and southern Italy has been recognized as a distinct subspecies, *Capreolus capreolus italicus*. A population of this endangered subspecies has been monitored in the Preserve of Castelporziano, near Rome, since 1988. This population has undergone a severe decline in 2000, due to a marked inter-specific competition with the Fallow deer. Since then, although fallow deer numbers have decreased strongly (-67%) the population of Italian roe deer is struggling to recover. Although the species is protected, the presence of a large Mediterranean forest and an extensive maquis shrubland as well as of potential predators (wild boars, foxes, weasels) that can affect the survival of newborns may have slowed down the population recovery. We followed a sub population, living in a fenced area of 400 ha devoted to crop production and livestock grazing, inside the Preserve. This population grew in density for several years (2008: 15 deer/km^2; 2012: 54 deer/km^2), becoming the largest group of roe deer in the Preserve. Then the density dropped and stabilized (2013-2015: 35–38 deer/km^2), showing a small and steady fawn/female ratio (2010: 0.8; 2013–2015: 0.3).

We examined timing and synchrony of births for 52 fawns belonging to 44 litters, from 2013 to 2015. We found differences in average date of fawning among years but not in the dispersion of births, which where synchronized in all years: 80% of births took place in <15 days. Fawns exhibited a fast body development with a birth weight of 1290 g and a postnatal growth rate of 143 gr/day. We found a cohort effect on fawns growth pattern (in 2015 fawns growth rate was lower) while sex or date of birth did not affect it. Birth weight did not differ among years or between sexes while we found an effect of date of birth on it (fawns born before and during peak birth times were heavier than the belated fawns).

We also investigated the effect of cohort, sex, age of capture, body mass, spring rainfall, birth period, roe deer and foxes densities, on survival of 26 fawns (marked with radio-collars in 2014 and 2015) over the first 3 months of life. The fate of 7 fawns was unknown (the collars were found in the meadows) while predation accounted for 60% of the overall mortality. All females died or lost their collars within the first 3 weeks of life while only 3 males survived longer than 3 months. The survival was positively affected by the date of birth with fawns born before and during peak birth times showing higher daily survival. We did not find any effect of the other variables on vital rates, however more data and a longer monitoring period are required to improve the scarce knowledge on the factors affecting fawns survival and population dynamics in this area.

X Congresso Italiano di Teriologia

Using GPS collars to evaluate the association between livestock guarding dogs and flock: preliminary results

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Livestock guarding dogs (LGDs) are considered worldwide one of the most powerful prevention tools against carnivore depredation events on domestic animals. In areas of recent recolonization by wild predators, farmers have lost familiarity with these dogs, and have difficulties in adopting tools that contribute to the control of livestock losses by depredation because they require extra labor, at least in the first phase of implementation. One of the reason of the resistance of farmers towards the adoption of LGDs is the general belief that they cost time and money, returning low benefits and sometimes aggression issues when not directly under the owner's control. How these animals behave when left alone with the flock on pastures is mostly unknown. Very few studies were conducted to understand how LGDs protect the herds, mostly because depredation events are difficult to predict and thus difficult to observe, unless real time information on wild predators movements are available. Consequently previous studies on this topic were conducted mostly through indirect methods such as questionnaires, censuses of losses and focal animal sampling. In the scope of Life Medwolf (LIFE11NAT/IT7069), we fitted 15 LGDs and 7 sheep with GPS collars in 7 different farms located in Grosseto Province (Tuscany, Italy). Localizations were collected during 20-day sessions from 11/11/2015 to 04/01/2016. The devices recorded one fix every 15 minutes when the animal was active and one fix every 60 minutes when the animal was resting. We investigated the spatial relationship between dogs and sheep within the complex framework of an LGD evaluation exercise. GLMMs were implemented to evaluate the relations between dog-sheep distance value and some environmental and dog-related variables. As random variable, dog ID nested into the pasture was used. We calculate the UDOI (Utilization Distribution Overlap Index) and the VI (Volume of Intersection) Index for 50% and 95% kernel isopleths in order to quantify the overlap and the similarity in the use of the space for the core area and for the whole movement range. Our preliminary results show that sheep-dog distance was on average 92.13$\pm$116.49 meters (N=4622). Distance length was mostly influenced by environmental variables, while the herd size played a little role, and dog-related variables could not discriminate any relation. Distances between dogs and sheep tended to be longer where pastures were surrounded by forests and open areas or when the flock size was smaller. The mean utilization distributions (UD) of dogs and sheep for 95% kernel isopleth were nonuniformly distributed and had high degree of overlap (UDOI=2.19$\pm$1.2), while for 50% kernel isopleth had a partial overlap (UDOI=0.61$\pm$0.28). The similarity between UD estimates of dogs and sheep was instead less pronounced (95% VI=0.6$\pm$0.12; 50%=0.51$\pm$0.14). GPS collars allowed us to quantify the magnitude of the spatial relation between sheep and guarding dogs. As expected, LGDs spent the majority of their time close to livestock sharing the same areas but using the space in a different way. Although we cannot assert whether the LGDs we monitored were an efficient tool, it is reasonable to assume that a good LGD in proximity to its flock will be able to intervene promptly in case of wild predator's attack.

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