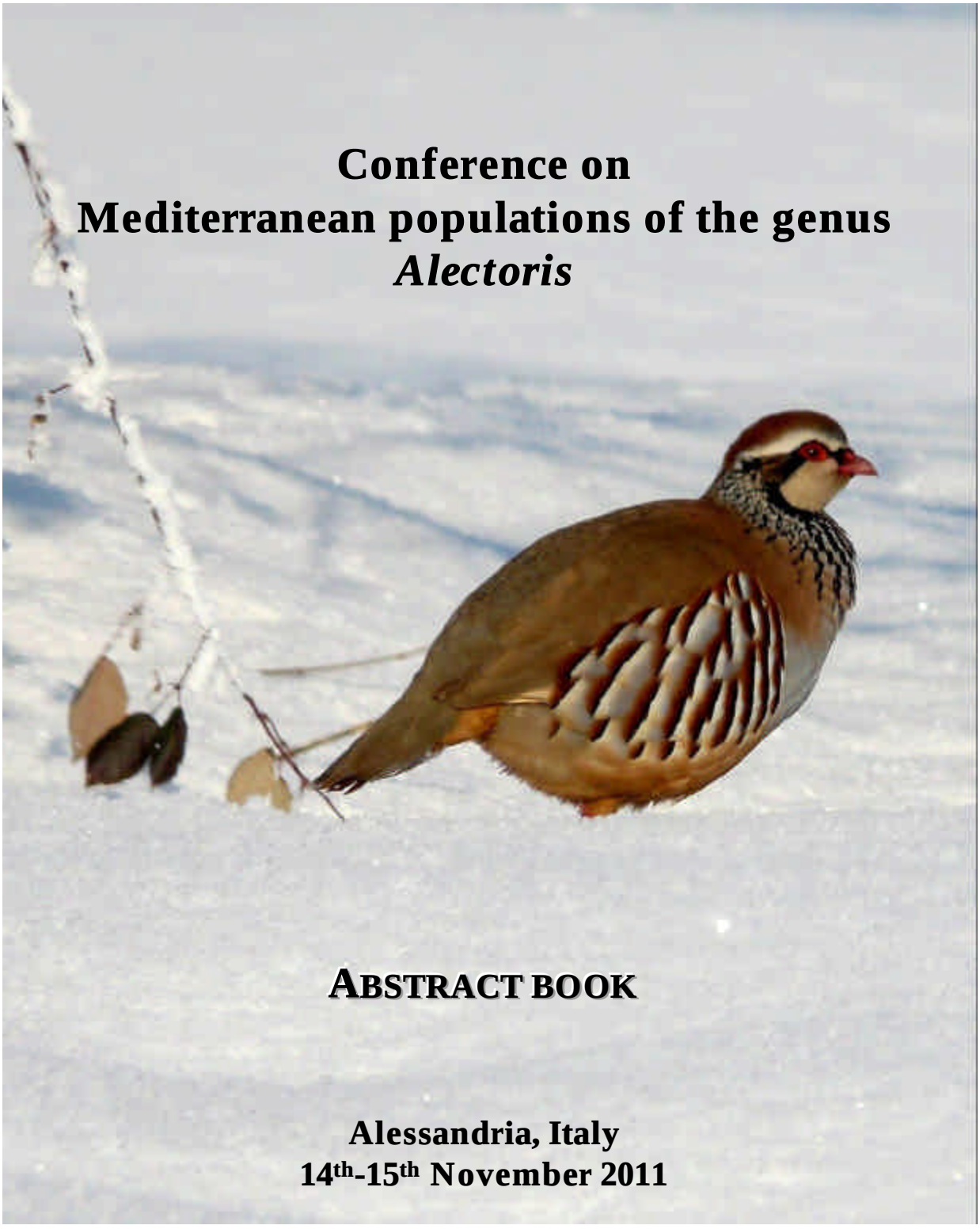
Conference on Mediterranean populations of the genus *Alectoris*



ABSTRACT BOOK

Alessandria, Italy
14th-15th November 2011

Conference on Mediterranean populations of the genus *Alectoris*

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Introduction

Dear colleagues,

Ladies and Gentlemen,

The University of Eastern Piedmont Amedeo Avogadro, the University of Turin, and the ATF (Associazione Ambiente Territorio e Formazione) are pleased to welcome you to the first conference on the *Mediterranean populations of the genus Alectoris* to be held in Alessandria the 14 and 15 November 2011

Many game and wildlife scientists, reaching Alessandria for this event, have acknowledged the great opportunity of sharing the advancement of our researches and our field works in this specific topic. Eight sessions covering the major aspects of partridges biology and ecology will be the occasion for fruitful exchanges of ideas and to launch new initiatives in the study and management of galliformes. The eight main lectures will shed light on each topic while oral and poster contributions will detail the situation of national and Mediterranean research. Even if the contributions of Italian authors in this first conference are prevailing, we are sure that in future editions, on turn, more European and north African realities will join us may be as a "partridge forum".

The wide range and high quality of the submitted presentations promise a very interesting conference which will sure give us new ideas about the problem of *Alectoris* genus conservancy.

Our deepest gratitude goes out to all those who have lent us their time and support during the preparation of this Conference. In particular we want to thank the patrons and sponsors, and all of you who honour us with your presence here today.

We sincerely hope that you will enjoy your time during the Conference in Alessandria.

Giorgio Malacarne
University of Piemonte Orientale

Pier Giuseppe Meneguz
University of Turin

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ABSTRACT

Lecture

Differences in the breeding ecology of *Alectoris* and *Perdix* and implications for the conservation of Alectoris.

POTTS G. R. (DICK)

International Council for Game and Wildlife Conservation

Nest predation is significantly higher in *Alectoris* than in *Perdix*. However these losses and a lower clutch size are largely offset by double-nesting.
Alectoris chicks accumulate grit from hatching whereas *Perdix* delays the process for ten days. In England the advantage of the extra grit enables *Alectoris* to break open unripe grass seeds and reduces the demand for insects. In Portugal the main purpose of the grit appears to be the fragmentation of hard insects rather than seeds.
It follows that the control of nest predation is more important in *Alectoris*. It may be possible to reduce this predation as top-predator abundances are restored. Contrary to some earlier views, insect abundance can be a very important determinant of chick survival and management to increase the abundance of chick food insects would be effective.

Oral communication

Status and distribution of *Alectoris graeca* in Apennine areas.

SORACE A. [1], ARTESE C. [2,3], ANTONUCCI A. [4], BERNONI M.[1,2], BONANI M. [2,5],. BRUSAFERRO A.[5], CARAFA M.[4], CAROTENUTO L.[6], CORTONE P., DE GABRIELE F., DE SANTIS E. [7], FORCONI P., MAURO F. [2], FULCO E., GUGLIELMI S., LATINI R.[8], LIBERATOSCIOLI E. [4], MAGRINI M., MANGIACOTTI M.[5], MARIANI F., PELLEGRINI M.[2], PERIA E.[6], PINCHIURRI V.[5], PROPERZI S., RIGA F. [9], SCALISI M. [10], SPERA M. [2], TROCCHI V. [9].

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Although recent genetic studies do not recognize subspecific rank for Apennine populations of *Alectoris graeca*, they have been isolated and demographically independent from all other populations of the species since the beginning of the Holocene (10000 years ago). Thus, some authors suggest considering the Apennine partridges as a distinct management unit. In spite of the conservationistic value of Apennine populations, scarce information is available on their current status. In this contribute, data on recent distribution of *Alectoris graeca* in each Apennine region are reported. Moreover, for Lazio, Abruzzo and Campania regions data on census in the majority of areas of species presence are included. Some quantitative data are reported also for some areas of Marche and Umbria region. The size of some regional populations was estimated. On the whole, the results indicate that the populations of Abruzzo regions (about 1500 pairs in four main areas) constitute the bulk of the Apennine partridges. Nevertheless, important local populations are present also in some areas (e.g., Monti Reatini, Monti Sibillini, Cilento) of other regions. The presence of *Alectoris graeca* is almost limited to protected areas. Besides excessive hunting pressure, other factors negatively affecting the conservation of *Alectoris graeca* in the Apennines are habitat changes (i.e. pasture abandonment), release of captive-reared birds and fragmentation of areal with consequent isolation of populations. Other possible negative local factors, are the high density of *Sus scrofa* and the presence of wandering dogs.

Oral communication

An habitat suitability model to predict the distribution area of Rock Partridge (*Alectoris graeca*) in the Central Italian Apennine.

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Rock Partridge (*Alectoris graeca*) has decreased in the last decades both in the Alps and in the Apennine as a consequence of many short and long-term reasons, including habitat characteristics. This is relevant in the Apennine were an endemic subsp. (*Alectoris graeca orlandoi*, Priolo, 1984) was described, although recent genetic analysis to consider this endemism as a population.
The aim of this paper is to study the potential distribution of the Rock Partridge on the basis of an habitat suitability model in order to promote the conservation of the species in the Apennines. The study area is represented by the Lazio Region were a census program was performed since 2005. Presence data were obtained by both pre and post reproductive census. Land cover data, obtained by photo interpretation of aerial photographs (2000) and landsat images (1999), were used to derive the landscape characteristics. Geographical and land use predictors were evaluated in a GIS environment to identify the most relevant factors influencing the presence of Rock Partridge during the nesting period. Logistic regression was then implemented to create a model for predicting Rock Partridge nesting site habitat characteristics. The adequacy of the model was tested on random selected points extracted during each census transect. The results showed that, on a local scale, slope (log), distance from forests, and the presence of bare rocks were statistically significant factors. On a landscape scale, the percentage of forests, the presence of sparse vegetation (over 60%), and a negative Mean Shape Index (MSI) were found to be statistically significant. The results showed a very high habitat fragmentation and relevant distance by patches of suitable habitats, in addition the suitable patch dimension is limited mainly in some areas. The model, if compared to that obtained in the Alps, produce some differences useful for describing the presence of the species in the Apennines.

Oral communication

Density and habitat suitability of the Red-legged Partridge (*Alectoris rufa*) on the Elba island (Tuscany)

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The Red-legged Partridge (*Alectoris rufa*) is an important game-bird species in Europe and it is classified as SPEC 2 due to a marked population decline. Losses of suitable habitat are considered the major cause of its decline and this can be related both to the agriculture intensification and to the abandonment of agricultural practices in more natural landscape. Habitat suitability models are an important management tool to define the potential distribution of the species, in order to design the protected area network, to plan correct management actions and to evaluate their effects. The study was conducted on the Elba Island (Tuscany) in spring 2011 in order to individuate the habitat factors that affect species distribution and population density in a typical Mediterranean landscape, and to plan habitat improvement actions. We subdivided the island in 1023 cells of 25 ha by a 500-m spaced grid and we carried out call counts in 196 randomly selected hearing points. We estimated pair density by point transects method and Distance Sampling and we measured the land-use variables from vegetation map and the orographic ones from the digital terrain model in each cell. We formulated Resource Selection Probability Functions following a presence vs. availability design by using Logistic Regression Analysis, Ecological Niche Factor Analysis (ENFA) and the Maximum Entropy approach (MaxEnt), and we obtained a map of potential distribution of the species calculating for each cell the average probability of presence across all model. Moreover we performed Multiple Regression Analyses to individuate the most important habitat variables affecting pair density and to obtain a map of the potential density of the species. From our analyses it seems that Red-legged Partridge distribution and density are mainly linked to the patchy habitat with garigue, Mediterranean scrubland, and meadows, whereas agricultural landscape has a negative effect both on presence probability and density.

Poster

The impact of agro-pastoral abandonment on the Rock Partridge in the Apennines.

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Human depopulation of rural mountain areas and the consequent abandonment of traditional land management are some of the greatest driving forces behind changes in mountain ecosystems in Western Europe. Tree and shrub encroachment lead to an increase in landscape matrix uniformity and habitat fragmentation. For some animal species, this represents an unusual case of habitat loss caused by secondary succession. The animal species associated with this agro-pastoral habitat may suffer from decreased connectivity as a consequence. The Rock Partridge is a species endemic to European mountains that represents a model species for investigating the impact of habitat loss. We compared the habitat suitability of the Apennine Rock Partridge prior to abandonment of traditional agro-pastoral mountain activities with the current landscape, in order to investigate the effect of secondary succession on the distribution and viability of the species. We analyses the historical distribution (c. 1900-1950) by quantifying anecdotal evidence from interviews, and the current distribution (2005) from survey data. We applied Ecological Niche Factor Analysis and connectivity approaches to evaluate change in habitat suitability over this time scale. Moreover, in order to quantify landscape connectivity, we evaluated the relative importance of each patch in the two considered periods. Results indicated that the species requires an ensemble of ecological conditions considerably different from the current situation in order to maintain a viable population in the Apennines. We observed a drastic decrease in connectivity as a result of the reduction in numbers and size of high suitability patches. This is most probably the primary cause of the current decline of the Rock Partridge population in the Apennines.

Poster

Alectoris graeca in Latium region (Central Italy): Status and Action Plan.

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Alectoris graeca shows an unfavourable status in Italy and Europe. Agenzia Regionale Parchi (ARP) of Latium Region in cooperation with the national Istituto Superiore Protezione e Ricerca Ambientale (ISPRA) undertook an investigation on the conservation status and distribution of this species in Latium. The main aim of the project was to draw up the regional Action Plan for *Alectoris graeca* in order to correctly manage its populations. Since the summer 2007 to the spring 2009, in the open and rocky habitats potentially suitable for the species, data on the status of *Alectoris graeca* were collected. In spring, the partridges were recorded using playback technique whereas in summer, census was carried out with the help of pointing dogs. *Alectoris graeca* is confined to some Apennine areas, mainly protected areas (national parks, regional reserves, etc.). The species was not observed in pre-Apennines mountains (M. Lucretili, M. Cairo) and anti-Apennines mountains (M. Lepini, M. Aurunci), where it was formerly present. Collected data were used to develop an habitat-suitability model following the Ecological Niche Factor Analysis (ENFA) technique. The regional Action Plan individuates several actions which can produce positive effects for the conservation of *Alectoris graeca*. Some of these actions aimed to the preservation and improvement of breeding habitats, others to the control of limiting factors (isolation of populations, poaching, genetic pollution). The Plan highlights also some actions to monitor the demographic parameters of the species, to investigate its sanitary status, to promote genetic analyses and to improve the knowledge on the species ecology.

Poster

Status of Rock Partridge (*Alectoris graeca*) in Lazio Region, Central Italian Apennine: five years of monitoring.

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2 Wildlife manager

In this paper we present the results of a monitoring plan devoted to study the distribution area and abundance of Rock Partridge (*Alectoris graeca*) in a portion of Central Apennine represented by the Lazio Region.
The presence of the species was detected both by playback censuses in spring (breeding season) and by the technique of trained dogs in summer (post-breeding).
In the Province of Rieti in the period 2005-10 have been heard / seen 148 male using the technique of playback, the sightings of breeding pairs ranged from 32 to 40 / year with an estimated density ranging from 0.50 to 0.62 and from 0.12 to 0.15 breeding pairs / 100 ha of suitable nesting areas, in the ban hunting areas and hunting one respectively.
In the province of Frosinone, in the period 2007-10, had been heard / seen 49 territorial males, the sightings of breeding pairs ranged from 15 to 17 / year with a density ranging from 0,62-0,54 and 0,27-0,31 breeding pairs / 100 ha of suitable nesting areas, in the ban hunting areas and hunting one respectively.
The small number of Rock Partridge in the investigated area of the Apennines is probably due to several factors, including changes in habitat as an effect of territorial dynamics, reduced livestock use of upland areas, poaching.

Lecture

Conservation genetics of the *Alectoris* partridges.

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The *Alectoris* partridges include seven closely related interfertile species distributed in Eurasia, China and southern Arabia. Their distributions are largely allopatric, with natural hybridisation in parapatric contact zones. Populations of the Mediterranean Alectoris (*A. rufa, A. graeca, A. barbara, A. chukar*) in some cases have declined in part of their native range, due to habitat changes and over-hunting. Population decline has been contrasted by translocations and massive releasing of captive-reproduced partridges, often using chukars (*A. chukar*) or hybrids with chukars. Thus, conservation of Alectoris species and genetically unique local populations should be based on detailed knowledge of their phylogeographic structure, the assessment of historical *vs* recent anthropogenic changes, and the detection of hybrids or admixed populations. In this presentation I will revise the main results obtained in a number of ongoing research programs and suggest some guidelines for wise conservation plans and sustainable management actions.

Oral communication

Genetic status of the Sardinian Partridge (*Alectoris barbara*) population.

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A North African Partridge, *Alectoris barbara*, inhabits the Sardinian island, as consequence of a possible historical translocation. This makes the Sardinian partridge a peculiarity for Europe, but at the same time it amplifies the risk of genetic contamination. We have investigated its genetic status, as regards both the extant levels of genetic diversity and the possible contamination due to introgressive hybridization with other Mediterranean species. For the purposes of this study, we analyzed 65 samples of Sardinian Partridges, 40 of which from the wild population and 25 from captive stocks. None of them showed a mtDNA PCR-RFLP haplotype assigned to other species than *A. barbara*, thus ruling out a possible introgression in the matriline. In addition, we compared these samples with 94 Partridges from other circum-Mediterranean populations using a set of 8 chicken microsatellites. Low levels of genetic variation were observed in the Sardinian population (HE = 0.310; kAR = 2.69), comparable only to those observed in the Sicilian rock Partridge (*A. graeca*). A comparison with the Tunisian population showed that its present genetic composition is consistent with a historical introduction from North Africa, showing possible effects of a post-introduction genetic drift. Bayesian tests assigned all but one individuals with > 90% probability to *A. barbara*, thus providing evidence that no massive introgression of exotic genes, possibly associated with restocking activities, has compromised the Sardinian population.

Oral communication

Pure Red-legged *Alectoris rufa* and *A. chukar* -contaminated partridges populations living in near areas of NW Italy.

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The north Italian Appenine landscape represents an elective habitat for the Red-legged Partridge.(*Alectoris rufa*). The massive release since '60 (for hunting purposes) of Chukar Partridges (*Alectoris chukar*) and /or alloctonous Red-legged Partridges, casts some doubts on the presence of the autoctonous populations living today in the whole NW Italy, increasing the problems of a correct conservation of this 'high concern' species. In this paper we have investigated two ecologically-different areas (from Alessandria province NW Italy), that have been subjected to different management policies and examined the genetic structure of their populations. In the elective agricultural habitat historically subjected to a traditional management (Brignano Casasco) maternal mitochondrial DNA (mt-DNA) and bi-parental microsatellites markers induce to exclude the presence of chukar contamination. This population appears demographically stable. In the second area, a riverine habitat unusual for the species, where partridges have been observed only since 32,2% of specimens show chukar mt DNA haplotypes. Surprisingly this "new" population shows a increasing trend. We hypothesise that in NW Apennines, pure and genetically contaminated populations of Red-legged Partridge with different population dynamic can coexist and different historical and /or actual management have influenced their status.

Poster

Barbary, chukar and red-legged: 10 years of research on *Alectoris* partridges at the University of Pisa.

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Since 2001 we have been investigating the genus *Alectoris* focusing on conservation, population genetics and molecular evolution of Barbary (*A. barbara*), Chukar (*A. chukar*) and Red-legged (*A. rufa*) Partridge. With the Italian Forest Service (Lucca) and the Centre for Livestock and Wildlife Recovery (Sassari) we produced *A. barbara* x *A. rufa* hybrids of different generations. We investigated the evolutionary affinity between these species and set-up RAPD markers to protect European *A. barbara* from the pressing threat of hybridization with introduced-to-Sardinia *A. rufa*. Correspondence between RAPD bands and nuclear loci was proved through the sequencing of markers. Working with the Estación Biológica de Doñana (Seville) we established *A. rufa* vs. *A. chukar* species-specific RAPDs that allowed us to disclose hybrids between the two species with higher effectiveness than using microsatellite DNA loci. These RAPDs were ISO-17025 patented to the Genindexe laboratory (La Rochelle) for *A. rufa* genetic management in North West France. Analysis of modern and ancient *A. rufa* DNA performed with the University of Illinois (Chicago), unveiled the recent origin of the pollution between Red-legged and Chukar Partridge. With the Hunting Federation of High-Corsica (Bastia) we proved that Corsica hosts the best genetically preserved *A. r. rufa* population. In collaboration with the Game & Wildlife Conservation Trust (Fordingbridge), we are investigating *A. rufa* in UK. With the Government of Cyprus and several Asian institutions we showed that two groups of *A. chukar* subspecies exist across Eurasia, and that the genes polluting *A. rufa* came from East Asia as the introduced-to-USA *A. chukar*. We provided indications to aid management of Mediterranean *A. chukar*: Cyprus hosts the most genetically preserved population. We realize that use of molecular techniques is costly; nonetheless, this would be in the best interest of both farmers and hunters. We recommend *ex-situ* breeding programs making strict use of local specimens identified through DNA barcoding.

Poster

Genetic structure of Rock Partridge (*Alectoris graeca*) populations in the central southern alps.

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The D-loop hypervariable control region of mitochondrial DNA has been investigated for 19 Rock Partridges *Alectoris graeca saxatilis* hunted in the alpine area of Val Brembana. Phylogenetic trees have been obtained for the animals sampled and the genetic distances between related individuals have been calculated. It has been possible to identify 3 clusters (5 haplotypes) and two separate individuals through Maximum Parsimony Analysis. A homogeneous group (A) was found to be present only in the southwestern part of the district, while group B was found to be distributed in the northern and southwestern sectors and a third group (C) in the southeastern and northeastern areas. The presence of a genetic group (A) represented only by individuals from the southwestern sector, with a node that differs from the other clusters and from the gene bank, seems to suggest the presence of a different group of animals when considering the rest of the population. Two individuals, also located in the southwestern region, were totally separated from the rest of the population of Rock Partridges sampled in the Val Brembana. Several hypothesis can be stated to explain these results and one of them is the possibility of genetic introgression with Ciukar (*Alectoris chukar*) due to the expansion of this species from areas adjacent to Val Brembana, together with some local genetic pollutions due to intakes with external populations, occurred in the early 90's; in those years approximately 200 juvenile partridges of unknown origin were released from a farm located in the nearby town of Taleggio. The southwestern area, where 2 clusters (3 haplotypes) plus 2 individuals have been identified, has shown in the 5 year sample period the highest reproductive success index (RI) with 5.34 chicks for female and high juveniles / adults (J / A_k) kill ratio (2.37). The northeastern sector, with 2 cluster (3 haplotypes) follows with RI = 4.41 and $J / A_k = 1.57$. Genetic testing can identify the presence of isolated populations and possible introgression of alien species. The research was supported by Comprensorio Alpino N° 1 Val Brembana Hunting preserve.

Poster

On the status of the Cyrenaic Partridge (*Alectoris barbata* Reichenow, 1896).

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After a comparison of morphological characteristics of specimens of *Alectoris barbara* from Sardinia, Tunisia and Cyrenaica, we think might be correct what has already been expressed by Ghigi in 1923 and until now not considered: the Cyrenaic Partridge (*Alectoris barbata*) has some differences such that it can be considered true species. Currently, however, it is considered subspecies of *Alectoris barbara.*
Among the differences we can remember the shape of the feathers of the throat, the presence of a single black bar on the feathers of the sides together even to a small, reduced, brown apical bar, and the shape and colour of the collar and eyebrows.
Genetic investigation is under way to obtain other information from this approach.

Poster

Sightings of *Alectoris rufa* from different Piedmont valleys.

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In Italy are reported three species belonging to genus *Alectoris*: the Red–legged Partridge *Alectoris rufa*, the Rock Partridge *Alectoris graeca* and the Barbary Partridge *Alectoris barbara*. The Red–legged Partridge and the Rock Partridge in some cases can hybridize and produce fertile offspring. They can show intermediate phenotype and behavioural characteristics between parental taxa (M. Ceugnet et Aubin, 2000; Randi et Bernard Laurent., 1999). Even *Alectoris chukar* has been used in the last years for restocking purpose in game management. This last species can also hybridize with *Alectoris rufa* although it entails genetics and sanitary problems and an overall impact on population fitness (Barilani et al., 2007). During spring counts of *Alectoris graeca* carried out in three Piedmont valleys at an altitude ranging from 1,500 to 2,200 meters above sea level, we observed some individuals that from phenotypical features were identified as *Alectoris rufa*. In order to understand the reasons underling these observations we analyzed all the available sources of information on *Alectoris rufa* presence and restocking operations in Piedmont region. The databases used were: *i)* wildlife management plans; *ii)* unofficial verbal reports; *iii)* official species range; iv) analysis of animals delivered to regional control point for hunted wildlife.
The results of our analysis were: i) no official data about release of *Alectoris rufa* are present in our study area; ii) no documented overlap between the areal of the two species is reported (except for a narrow area in the Southern part of Maritime French Alps). iii) The presence of *Alectoris rufa* individuals is probably due to illegal restocking operations.
The impact of *Alectoris rufa* presence on populations of *Alectoris graeca* is discussed.

Lecture

Physiological and behavioral interactions in ecology: lessons and perspectives for the conservation of partridge populations.

BOOS M.

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Overall in Europe, partridge species are under fluctuating conservation statuses. The main indentified threats have been changes in agricultural practices, variations in predation pressure, habitat and anthropogenic disturbances linked to global climate changes and human leisure activities. To improve management tools, one major goal is to better understand the ecological functioning of these non-migratory species. Many studies have focused on the behavior monitoring and how individuals use their habitat. However, little is known on how those birds manage their body fuel reserves especially when facing harsh weather conditions in winter, on how they respond to different stress events and how these responses affect their survival and reproductive capabilities. During this session we will focus on recent investigations dealing with physiology among bird species and how the interaction with behavior monitoring can contribute to better understanding the mechanism underlying life history traits among partridges. Recently, the increasing number of studies showing the importance of the starvation-predation risk trade-off and stress responses on fitness will help to promote new research perspectives with practical lessons for the conservation of wild partridge populations. All these subjects will be discussed during this presentation.

Oral communication

Morphological and behavioural posthatching development in the Barbary Partridge, *Alectoris barbara* (Aves: Galliformes: Phasianidae).

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Morphological and behavioural posthatching development was investigated in wild-originated hand-reared Barbary Partridges (*Alectoris barbara*). Growth curves for body weight and seven morphometric parameters of wing, leg and sternum were described using growth models and were characterized by the ratio of exponential growth rate EGR to relative size (ln(W / A)); W= size at a given age; A= asymptotic size). The behaviour was monitored from 2 to 49 days after hatching. Five-mn behavioural sequences were video-recorded three times per day for different age classes. They were analyzed using JWatcher software. Males were larger and heavier than females, but with no significant difference in growth rates. This was the same for adults from mountains compared to those from lowlands. A comparative analysis of developmental trajectories among Galliformes showed that *A. barbara* presents heterochronically an intermediary degree of precocity of development. Furthermore, using a multivariate approach, we show that development of different parts of the body is coherent. The time allocated to social interactions increased with age from 7±1.9% at 2-4 days to 23±6.8% at 32-40 days and decreased afterward. Huddling was the predominant social behaviour. Chicks exhibit since the age of 11 d, aggressive behaviors, but with a low frequency. Most of the recorded behaviours were observed early after hatching, suggesting that chicks do not require any parental learning to develop such behaviors. The behaviours that need a certain degree of maturation such as fledgling and dust-bathing occurred only at one week of age. Heating frequency progressively decreased with age in relation to the homoeothermy acquisition.

Oral communication

Behavioural and hormonal partner compatibility in captive *Alectoris graeca* pairs.

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The Rock Partridge (*Alectoris graeca*) lives in Alpine habitats and the available information on behavioural and physiological mechanisms, e.g. during pair bond formation and maintenance, is limited. We do not know whether the Rock Partridge is monogamous in fact and whether pair bonds are long-term or newly formed every spring (as Grey Partridge, *Perdix perdix*) or already during winter (as Hazel Grouse, *Tetrastes bonasia*). From studies with captive birds we may learn about individual social behaviour and hormonal responsivity. We have validated the measurement of excreted testosterone metabolites (TM) from droppings in both male and female *A. graeca*. On top of seasonal TM patterns we observed individual variation of seasonal TM. We then shifted to the pair as the operative unit of analyses. To test whether the breeding success of *A. graeca* pairs is modulated by hormonal or behavioural partner compatibility we conducted experiments in the birds' original high altitude habitat. Eight former pair partners and ten newly formed pairs were kept in aviaries from February until July after their chicks had hatched. We collected individual droppings regularly for monitoring individual seasonal TM patterns and measured reproductive output. Furthermore, the birds' individual behaviour in response to the experimenter's presence while collecting droppings was scored during different seasonal phases. First results on behaviourally and hormonally synchronized partners indicate that pair bonds were restricted to one breeding season. I will discuss issues, which could be studied using the methods we have introduced with the presented study.

Poster

Fall diet of the Rock Partridge (*Alectoris graeca saxatilis*) in the central sector of Italian Alps.

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Rock Partridges were collected during three hunting seasons (2006-2008) to study fall food habits in order to identify important food resources and to estimate food selection by the species in relation to plant availability.
We collected 111 partridges from Hunting Districts of Chiavenna and Morbegno (Province of Sondrio): 61 samples were from Retic Alps and 50 from Orobic Alps. We identified food items consumed by partridges based on the microhistological analysis of stomach contents.
Moreover plant availability was sampled in seven study areas located in both hunting districts where partridges were shot. All the plant species were identified within random plots (1 m radius) scattered in every study area, and their ground cover were estimated. On the whole we identified 37 plant species belonging to 21 families: the most frequent family was Graminaceae, followed by Juncaceae and Compositae. Partridges positively selected *Agrostis rupestris, Poa alpina, Silene acaulis* and *Hieracium pilosella*. *Vaccinium myrtillus* was avoided, while *V. uliginosus* and *Rhododendrom ferrugineum* were used as their availability.
Diet breadth was similar between the 2 hunting districts, age-classes (juveniles *vs* adults) and between sexes; males and females used same food items therefore their diet greatly overlapped.
During the autumn season, Rock Partridge seemed to use food resources as their availability; indeed the species diet breadth was neither narrow nor wide. The fall food habits of the species could be partially enhanced by the location of the Sondrio Province along the southern boundary of the species distribution in Central Alps; as a consequence the species could adjust itself to plant availability in the fall season by using the greater part of available species and actively selecting only few plant species.

Poster

Distribution and genetic characterization of some Partridge Population in Tunisia: An Eco-toxicological study.

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Due to its geographic position, Tunisia is home to an impressive number of species of birds that vary from residents, breeding to migrants. Among Tunisian birds checklist we can found the Barbary Partridge (*Alectoris barbara*) that was in the center of many concerns during the last two decades. Uncontrolled hunting activities as well as ecotoxicological concerns were the main causes of population's declines and in some cases sites-specific disappearances of this genius. The first step for a sustainable conservation of *Alectoris* sp in Tunisia was the establishment of a reparation area of these birds with a genetic determination of the populations. The second step was the evaluation of the main threats ranging from Habitat protection to relevant ecotoxicological problems. In this work we provide the actual situation of partridge species and subspecies inhabiting Tunisian areas and the potential of their conservation in view of the ecological situation. A particular concern was dedicated to the evaluation of the main eco-toxicological reasons of the partridge population decline. Finally a molecular genetics determination of some population is provided.

Poster

Factors affecting defensive behaviour of Rock and Red-legged Partridges.

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In recent years our research group has extensively studied the defensive behaviour of rock and Red-Legged Partridges. Using simulated aerial and terrestrial predators we described defensive behaviour of Rock Partridges and the effect of early exposure to potential predators. Our findings show that the defensive behavior of the Rock Partridge is influenced by type of predator, and early threatening experience of potential predators. In the Red-legged Partridge we studied the effect of the presence of an audience on the expression of defensive behavior. Our results show that males in presence of their mates warn them increasing calling rate and produce less detectable calls.
To summarize, defensive behavior of these species of the genus *Alectoris* can be modified by type of predator, experience or audience composition.

Lecture

Factors affecting Red-legged Partridge population dynamics: a review and new insights.

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The Red-legged Partridge is the most important gamebird in the Iberian Peninsula, but their wild populations have strongly declined during last decades. The main habitat of the species is a combination of agricultural land, mainly dry crops, and natural vegetation, grassland or bushland, reaching maximum densities in areas of typical Mediterranean climate with fragmented agricultural landscape. The species has a peculiar breeding system, based on double brooding, with about half of the males attending a nest during normal years. Available information indicates that hunting, predation and diseases are the main mortality factors of adult and sub-adult birds. Recent hunting bag analyses and radio-tracking research indicates that a combination of changes in agricultural management, mainly agricultural land concentration programs, shortening of cereal cropping cycles, and reduction in the area covered by marginal natural vegetation patches ("lindes" and fallows), along with overhunting of declining populations, can be considered the main factors behind the demographic decline. The first demographic models using parameters recorded in northern Spain indicate that nesting success is the crucial phase of the life cycle. Agricultural management, mainly early cereal harvesting, is the main cause of nesting failure both in southern and northern Spain, causing up to three times more losses than predation. Recent research in southern Spain based on large-scale census by road transects during breeding season showed that nesting success in a particular area is negatively affected by the area covered by agricultural land, thus supporting previous information obtained at smaller scale. Although predation is often considered the main problem of partridges by game managers, available information does not support this view. However, sound experimental work testing the effect of predation on this species is still missing. As a consequence of the wild population declines, releases of farm-bred birds have exponentially increased during last 30 years, currently reaching probably up tot 5-6 million birds released yearly. However, available information support that these releases are not useful to recover wild populations at large, although they have promoted a recovery of hunting bags. On the contrary, wild population nesting success seems to be negatively affected by releases. Releases of birds hybridized with Chukar Partridges in farms have been common, and we have recently shown that these hybrid birds can successfully breed in the wild, even laying larger clutches than "pure" partridges.

Oral communication

Abundance of Rock Partridge (*Alectoris graeca*) in relation to the multi spatial structure of habitat and food availability.

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In the Prealpi Giulie Natural Park the distribution and abundance of the Rock Partridge *Alectoris graeca saxatilis* have been studied in 5 sample areas using the play-back technique, and related to habitat availability (Vegetation Map of the park, 1:25.000) at different spatial scales. The UTM 1x1 kilometer regional grid has been used for a large scale approach, assigning the number of partridges counted to each quadrant. The mean geo-morphological aspects, the herbaceous and shrub vegetation characteristics (density, height, colour, etc), the abundance of insects (pitfall traps), and management applied on the area (pasture, mowing, etc) have also been measured for each quadrant. Buffer surfaces of 500 and 100 meters of radius from the detection-points of the animals have been used respectively as medium and small scale approaches and compared to randomly selected buffer areas. GIS analysis has been carried out to determine habitat coverage in each quadrant and buffer. Different parameters seem to describe properly the ecological requirements of this species in the study area. Its abundance was correlated at all scales to grasslands widely colonized by *Genista radiata*. This element, together with high herbaceous vegetation at large scales, could provide shelter from flying predators. At medium to small scales species-rich mesophile hay meadows seem to enhance the presence of Rock Partridges, locally providing a large stock of food resources and together with xeric grasslands representing the optimal mixture of habitats for this phasianid. In contrast pastures colonized by shrubs and trees (high density, large diameter) seem to have a negative effect on the species presence at large to small scales. This multiscale approach allows to detect more appropriately the ecological requirements of this animal.

Oral communication

Habitat suitability model for alpine Rock Partridge (*Alectoris graeca saxatilis*) in Piedmont mountains: a mid-term study.

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Alpine Rock Partridge decline on the whole alpine mountain range is due to several reasons. Most of them are direct causes such as high hunting pressure, poaching, restocking and wrong management decisions. Mediate causes such as habitat fragmentation may be linked to habitat changes as effect of both natural (global warming) and artificial (pasture abandonment) causes. These alterations have been leading to an overall reduction of suitable area. Habitat suitability models combined with time series can provide an important tool to understand how and how much these landscape modifications may be liable of the decline of the species.

This study was conducted within the interreg project 'I galliformi alpini sulle alpi occidentali come indicatori ambientali: monitoraggio, conservazione e gestione delle specie – ALCOTRA 2007-2013 (project #88)', between Italy and France, under the supervision of Regione Piemonte, Office National de la Chausse et de la Faune Sauvage, Consiglio Nazionale delle Ricerche and Valle d'Aosta Region.

The study was performed in order to investigate if suitable areas for Rock Partridge in Piedmont changed during the last 18 years and if there were any variations in the importance of environmental variables in predicting the presence of the species.

For this purpose we developed different suitability models grouped by different periods, using 4996 presence data collected from 1992 to 2010 by Parks and hunting districts. We performed different Resource Selection Probability Functions following the Maximum Entropy approach (MaxEnt) to obtain one model and a map of potential distribution of the species per year. From each model we extrapolated the permutation importance of each variable that gives a measure of the contribution of that variable to the model. We performed autoregressive moving average models (ARMA), autoregressive integrated moving average (ARIMA) and regression analysis with curve fit between years and i) permutation importance of each variable; ii) coefficient of each variable; iii) suitable area as predicted by the model. Finally we performed predictions of the next 10 years.

Oral communication

Rock Partridge *Alectoris graeca saxatilis* occurrence in pastoral habitats. The Val Troncea Natural Park case of study.

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In this paper we present the preliminary results of a long term project concerning sustainable strategies for the conservation of alpine grazing-land biodiversity and multifunctional use in the Val Troncea Regional Park (Piedmont, Italy). In the study area the occurrence of Rock Partridge *Alectoris graeca saxatilis*, monitored since the late '80, was used to study the habitat selection and how traditional agro-pastoral practices and vegetation dynamics affect it.
In the project, cost-effective pastoral practices such as night camping and the placement of salt blocks to attract the livestock in the more marginal areas are proposed to improve habitat heterogeneity and diversity where they are decreasing due to under-exploitation of grasslands.
During summer 2010 we sampled 342 cells of a 150x150 m grid extended all over Val Troncea Park. Inside each cell we gathered data about woody and herbaceous vegetation composition, synecology, forage quality, species richness, canopy structure of herbaceous and shrub layers, grazing management, and topography (exposure, slope, altitude, solar radiation, extracted from DTM).
We found the signs of Rock Partridge presence in 174/342 cells. The species presence was positively affected by thermic condition areas, where mainly *Festuca* gr. *ovina* and other xerophilous vegetation types occurred. Partridge presence was also significantly associated to intermediate mesotrophic condition vegetation (*Festuca* gr. *rubra*). Canonical correlation analysis showed that high-altitude vegetations types and tall eutrophic swards were generally avoided. Conversely, partridge presence was not significantly correlated to oligotrophic (e.g. *Carex sempervirens*) and woody vegetation. Nevertheless *Juniperus nana* shrublands tended to be selected, as dynamically related to thermic vegetations types.

Poster

Expansion of Red legged Partridge's habitat in the southeast of the Alessandria Province: the rivers as ecological corridors?

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The natural homerange of the Red legged Partridge *Alectoris rufa*, is spread across Portugal, Spain, Andorra, France and Italy. In southern Piedmont the species has a fragmented distribution area, with populations that greatly vary in size. After several years during which the species appeared close to local extinction, some populations from Northwest Italy are now undergoing a demographic explosion. This is the case of the population, on which this research work is about, that lives in the southeastern part of the Alessandria Province (Italy), where hunting has now been forbidden for 15 years.
The expansion of this population began ten years ago and served as stimulus to start, in 2008, the project "Conservation and management of the Red legged Partridge in the Province of Alessandria". This research project has several goals, as to define: environmental features, population dynamics, and territory suitability. Here, we present the first results.
The size of partridge's habitat and its variations between the years 2008 and 2011, were evaluated by: *i)* data collection from a network of trained observers, capable to georeference signs of presence, and by *ii)* the capture-recapture survey of marked individuals.
The network allowed the collection of 315 presence signs which testify that the habitat is expanding northward, taking advantage of rivers, in particular Scrivia and Curone rivers, that appear as real ecological corridors.
The recaptures of previously marked partridges (in three years, we marked 231 animals) showed movements between 4 and 5 kilometers. These dispersion movements show that the species is able to rapidly colonize new areas.
The future of the Alessandria's Red legged Partridge population is discussed and reviewed in the light of these data.

Poster

Influence of weather-climate conditions on the reproductive period of Rock Partridge *Alectoris graeca* in a population of the western alps.

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The reproductive success of Rock Partridge *Alectoris graeca* is likely to be influenced by weather events, intense rainfalls and temperatures, which may occur during the reproductive period.
On this basis we compared the data obtained from the census of Rock Partridge, made through the use of pointer dogs in an area of the Southern Alpes (Alpi Cozie, Varaita Valley, CN), with data recorded by automatic monitoring meteorological stations of the regional network (ARPA Piemonte).
In particular they have been taken into account, from 2000 to 2010, meteorological parameters such as number of days of rain, intensity of individual rainfall events, number of consecutive days of uninterrupted rain and average temperature, minimum and maximum, recorded during the reproductive season (from the second half of May to the first half of August) in order to evaluate their impact on both eggs and chicks.
As for the demographic parameters measured during the summer censuses are taken into account the number and consistency of broods counted and the ratio of young / adult (reproductive success).
The purpose of this paper is therefore to model the relationship among climate parameters and reproductive success and assess its effect on population dynamics.
The results showed that climatic condition that occur during the reproductive season are crucial in the reproductive success. The climatic parameter that showed the strongest negative correlation with the reproductive index (R.I.) proved to be the maximum accumulation for single rainfall event in the second half of July (Spearman Test $r = -0,66$; $p < 0,05$).

Poster

Monitoring the dynamic of an increasing Red-legged Partridge population.

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Dealing with population dynamic of a species is a very difficult topic because it requires i) to monitor the population all year round; ii) to have a monitoring tool flexible and sensitive enough to be used both in springtime (counts of call and reproductive pairs) and in summertime (detection of brigades and evaluation of their consistency). The present work aims to present an *Alectoris rufa* monitoring protocol capable of monitoring both the springtime and the summertime consistency. The monitoring was carried out in Alessandria province, in two study areas that present very different environmental conditions (hill habitat versus river bank habitat) and population characteristics (pure population versus hybridized population).
The proposed monitoring method is based on the detection of the animals by spontaneous calling at dawn (Pepin et al., 1992), followed by an active research phase (for both pairs and brigades) that lasts till the study area is completely surveyed. The monitoring took place in 2010 and 2011. The results show that among all the calling males the 78,2% is able to form a reproductive pair. Moreover the 69,4% of the reproductive pairs is able to produce vital broods.
Our results point out that i) the proposed monitoring protocol gives very good results in terms of reliability and sensibility; ii) the alexandrine population, even if in the last year showed a very high numerical increase, it is potentially subjected to quick collapse, due to its dynamic features. The management implications of our results are discussed.

Poster

Effects of conventional agriculture and game-cover crops on Red-legged Partridge populations.

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The Red-legged Partridge (*Alectoris rufa*) is an important game-bird species in the western Palaearctic due to its commercial value, and it is classified as SPEC 2 based on two factors: a marked population decline from 1960s over Europe and a population spread limited to the European Country. The most important causes of the decline are the intensification of agriculture and the related loss of suitable habitats. Moreover, in Italy, overhunting played an important role in reducing population density thus causing extinction of species at local levels.
We studied habitat selection of Red-legged Partridge in two areas located in Tuscany Region with the aims of finding out habitat variables with positive effects on partridge population and evaluating the effects of game-cover crops on partridge density. Our study areas were characterized by different amount of spontaneous vegetation and game-cover crops. We monitored partridge pairs and broods by mapping censuses carried out in spring and summer 2005. Moreover we mapped land use by direct surveys and aerial photographs at 1:10.000 scale. For each study area, we delineated by kernel analysis at 99% belts of increasing density and we measured the percentage of land use types and landscape metrics. We carried out Multiple Regression Analysis (MRA, stepwise method) of pair and brood density calculated in each kernel belt vs. land use classes and landscape metrics. MRA on pairs and broods explained 82% and 50% of the variance of dependent variables by the inclusion of 8-3 habitat variables, respectively. The most important variables were game-cover crops in both cases. On the whole, variables linked to the habitat heterogeneity influenced positively both pair and brood density. In particular habitat variables with positive effects on pre-breeding and brood density were spring crops, clovers, fallow fields, vineyards and farmsteads.

Lecture

Diseases and parasites of the Red-legged Partridge: implications for management and conservation.

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Sanitary aspects of wildlife are relevant for public health, domestic animal health, conservation and game management. The Red-legged Partridge (*Alectoris rufa*), a member of the genus *Alectoris* native to southwestern Europe, is a key game species in south-eastern France and in the Iberian Peninsula whose free living populations are largely modulated by habitat, management, and diseases. This review aims to identify the most important pathogens for both partridge production in game farms and the conservation and exploitation of free-living populations. Recommendations regarding disease surveillance and disease control in game farms and in the field are included.

Due to the hunting pressure on wild bird populations, as well as the loss of habitat, Red-legged Partridge populations are decreasing to a point where hunting would have to be banned. In order to solve this problem, most countries have initiated farm rising of game birds that are later released into the wild for re-stocking populations and to satisfy the hunting demand. In Spain, about four million juvenile Red-legged Partridges are released each autumn. Unfortunately, there are no established husbandry procedures for raising these birds which results in high prevalence of disease in these animals, low post-release survival rates, and potential transmission of pathogens to multiple sympatric species of wild animals and a health risk for human consumers. Relevant pathogens of farmed partridges and of released farm-reared ones include mainly enterobacteria such as *Campylobacter*, *Salmonella* and *E. coli*, as well as parasites, particularly those of a direct transmission cycle.

Regarding free-living populations, viral diseases including avian pox and flavivirus infections can cause significant mortality. Bacterial diseases and parasites are comparatively less relevant, unless intense management with artificial watering and feeding -and thus high densities and increased spatial aggregation- facilitate their transmission. Parasites such as coccidia of the genus Eimeria and several helminths can also cause significant losses under favourable environmental conditions.

As opposed to conventional poultry raising systems, there are almost no regulations or monitoring systems in place to oversee the sanitary and health conditions in which game birds are raised.

Absence of sanitary controls results in high prevalence of enteric disease and as preventive measure the producers tend to use antimicrobials without prior susceptibility testing and in absence of control. These procedures can lead to the appearance of antimicrobial resistances and the spread of new mechanisms of antimicrobial resistance to other bacterial populations including human and animal pathogens. In this regard, disease surveillance is needed in farms and during re-stocking operations, as well as in free-living populations. Intervention opportunities are most evident in farms or during releases and far more limited in the field. These include mostly prevention, but also vaccination and both chemical and alternative treatments against enteropathogens and parasites.

Oral communication

Relation between parasites, reproductive index and habitat change in Rock Partridge (*Alectoris graeca*) populations in the central southern alps.

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Within the hunting district of Val Brembana the presence of parasites along the intestinal tract in 60 individuals (32 adults and 22 juveniles, 6 indeterminate) has been studied and correlated to the reproductive indexes (R.I, measured on 3 and 6 years) of Rock Partridges *Alectoris graeca saxatilis* in 6 different sectors and the habitat change. Within these sectors the coverage (%) of several environmental classes in different sample areas has been identified through photo interpretation over a time interval of 25 years. In the whole area a high spread of the nematode *Ascaridia* was observed and high values of prevalence (P = 69.49%) and mean abundance (MA = 15.21) have been found, while the presence of genus *Capillaria* was low with MA = 0.17 and P = 13.56%. *Heterakis* was isolated in 33.90% of the Rock Partridges, with MA = 1.45. For *Ascaridia* and *Heterakis* the relationship between variance and mean abundance (s2/MA) was significantly greater than one (*Ascarids* = 48.94; *Heterakis*: 7.90) and the aggregation index k (s2 / (s2-MA)) was very close to zero, proving that these parasites show a highly aggregated distribution within host populations. When analyzing separately the 2 age classes there seemed to be no significant difference in parasitic infection susceptibility between juveniles (P = 95.45%) and adults (P = 84.95%). Only MA and P of *Heterakis* in different sectors was negatively correlated to a change in reproductive success, both in short and medium term, while the sectors with the greatest MA of *Ascaridia*, both in short and medium term, showed the highest mean reproductive rates and the sectors with the highest k of *Capillaria* had the highest R.I. The presence of parasites and particularly the value of MA of *Capillaria* and the average total number of parasites seemed to increase with the decreasing of open areas (coverage) in the different sectors of the study area, as well as with the decreasing of this observed coverage throughout the 25 year period. A negative correlation between open areas and the s2/AM ratio was discovered to be very clear. The presence of open areas seemed to affect significantly the abundance of parasites that in turn seemed to only partially drive R.I changes. The research was supported by Comprensorio Alpino N° 1 Val Brembana Hunting district.

Oral communication

Helminths communities of Rock Partridge (*Alectoris græca*) in western alps: effect of age and sex.

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Alpine Rock Partridge (*Alectoris græca*) populations are drastically decreasing since 50ies. That is mainly ascribed to land-use change and progressive habitat degradation. Here we investigate their helminths communities, as population health index in relation to age classes and gender.

This study considers 208 Rock Partridge from Lepontine Alps (VB) gathered during seven hunting seasons (2003-09), with details collected on culling site, age classes, sex and weight. The intestinal contents of the total sample (90 adults, 39 males and 51 females, and 118 young), have been examined for helminths.

In females and young were identified respectively: *Ascaridia compar* (prevalence (p)=12%, mean intensity (i)=2,5 and p=15%, i=2), *Heterakis gallinarum* (p=76%, i=6,5 and p=63%, i=7) and *Aoncotheca caudinflata* (p=24%, i =1,7 and p=18%, i=2,3). In males two species were recorded with lower intensities and prevalence *H. gallinarum* (p=58%, i=11,7) and *A. caudinflata* (p=7%, i=1).

These data suggest a possible health impact on young, even if any effect has been observed on weight. The adult females higher infestation could be related to an immune-mediated effect consequent of hatching and post hatching energy expenditure. Moreover females raise chicks taking care of their feeding involving earthworms which are responsible for the transmission of the three helminths species, and the parasitological difference observed could be ascribed to a different feeding behavior. This is supported by the total absence of *A. compar* in males, despite the habitat shared by the three host groups.

Oral communication

Sanitary status of the Red-legged Partridge *Alectoris rufa* in the province of Alessandria, Italy.

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In spite of the ecological and socio-economical importance of the Red-legged Partridge *Alectoris rufa* information about its diseases are scarce. In Italy, only three scientific articles are available on the pathology of artificially raised *A. rufa* (Millan J., 2009).
In other Galliform hosts it was shown that parasitic infections may affect fitness traits such as the reproductive success and susceptibility to predation, and therefore have serious consequences at population level
In January 2009, 2010 and 2011, free ranging Red-legged Partridges were mechanically captured in 7 different locations in the province of Alessandria. Fresh faeces from the cloaca and a blood sample from the wing vein were collected and analysed for presence and prevalence of parasites. Other specimens of Red-legged Partridge were collected from occasional finding of killed animals.
A total of 267 Red-legged Partridges were examined (101 in 2009, 130 in 2010, 36 in 2011) and other 52 animals from finding of killed animals. The following parasites were observed: i) coccidian oocysts in the faecal samples. Morphometric data suggest the presence of two different species of *Eimeria* (probably *Eimeria kofoidi* and *E. legionensis*); ii) All blood samples were negative in 2009, a single sample tested positive for *Haemoproteus* sp. in 2010 (P=0,8%) and 3 positive samples in 2011 (P=8,3%). This represents the first report of the genus in *A. rufa* in Italy; iii) *Heterakis gallinarum* and *Ascaridia columbae* were detected in the small and large intestine. This two parasites species are reported for the first time in Italy in Red-legged Partridge. Moreover *A. columbae* is reported for the first time ever in Red-legged Partridge (for this reason a molecular confirmation of the report would be advisable).. Date generated in this survey will serve as base to investigate in greater detail the sanitary status of free ranging Red-legged Partridges in our country.

Poster

Responses to an antigen vaccine in laying females: differences between the Grey and the Red-legged Partridge laying females.

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The variable levels of susceptibility to infections are recognized as factors that can influence the population dynamics of many bird species. The Newcastle disease (ND) is regarded throughout the world as one of the most important infection of game birds. Within these birds, resistance to experimental ND infection seems higher in Red-legged Partridges and less efficient in Grey Partridges. In the two species, in a captive rearing condition, we experimentally tested the different levels of susceptibility of laying females, immune challenged with a NDV antigen vaccine, and its effects on the clutches. The challenged Grey Partridge females showed a higher erythro-sedimentation rate, a serum parameter related to worsened health conditions, while their cell-mediated immune reaction (PHAtest) did not differ from that of controls. The NDV-treated Grey Partridge females laid smaller eggs, while the concentrations of antibacterial substances (lysozyme and avidin, two enzymes that confer innate antibacterial immunity) were unrelated to the hen's immune challenge. The challenge in the Red-legged Partridge did not induce effects on female condition nor on egg quality. Our study confirms the different level of susceptibility in the two species and suggests that, in the more susceptible species, the Grey Partridge, an immune challenge can be costly also in terms of reproductive allocation in the egg. These results are discussed in the light of the epidemiology and management of these game birds.

Lecture

Lights and shadows of the Red-legged Partridge hunting management in central Spain.

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The Red-legged Partridge (RLP) is the main small-game species in central Spain, where the management of its populations is widely implemented. We assessed the relationship between hunting management techniques and summer RLP density, RLP hunting bags, and the abundance of other species of conservation concern (i.e. raptors and steppe birds). In addition, we studied in depth the use of predator control and farm-reared partridge releases, as these are the most controversial game management practices. We surveyed almost 60 RLP hunting estates between 2006 and 2009, recording management data through personal interviews, and using field surveys (point count method) to record the abundance of RLP and other bird species, and habitat data. In estates where great numbers were released (legally intensive estates), RLP harvest depended almost exclusively on releases. In non-intensive estates, farm-bred partridges released in small numbers did not increase annual harvest, which was mainly affected by wild stock availability. In turn, RLP abundance was positively associated with management practices such as provision of artificial ponds and feeders, but negatively with farm-reared birds release intensity. Water or food provision for RLP was positively associated to steppe-bird abundance, whereas no effects (positive or negative) were found between management and raptor abundance, although raptor diversity increased with RLP abundance. Predator control and RLP releases were widely employed in our study area, despite not being apparently related to partridge density nor to hunting bags. Interestingly, both social and economic factors (i.e. perceptions and types of estates, respectively) played a pivotal role driving predator control and partridge releases. According to these findings, habitat management seems to be the best option aimed at boosting RLP density (and bags), which importantly also favours other bird species of conservation concern.

Oral communication

Red-legged Partridge (*Alectoris rufa*) demographic models: application to hunting management.

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Red-legged Partridge (*Alectoris rufa*) populations in the Iberian Peninsula are declining in the last decades, but monitoring data are masked by the effect of generalized releases for game purposes. Therefore, identifying the main demographic parameters affecting partridge population dynamics is required in areas free of releases. One of these regions is Navarra (northern Spain), where the species also shows a clear declining trend during the last 20 years. During a field work carried out in 6 areas of Navarra (5.500-7.000 Ha) between 2006 and 2009 (February-November) we estimated demographic parameters such as adult and chick survival and several reproductive parameters. We also estimated hunting mortality from hunting bags and population estimates from different areas of Navarra. We developed different individual-based population models using Program Netlogo, and applied the models to different hunting scenarios. The population rate of increase was most sensitive to small changes in survival of pre-reproductive and nesting adults and survival of chicks between one and five months old. However, if only one parameter should be manipulated to achieve population recovery (lambda>1), either nest success or survival of chicks younger than one month should be improved. In more realistic scenarios, habitat management will improve simultaneously different parameters which would have larger effects on lambda. Parameters highly susceptible of improvement, due to their low estimated values in the field, are adult survival, nest success, and chick survival during the first weeks of life. Some realistic scenarios would allow partridge population recovery and higher hunting levels than those supported in the current situation.

Oral communication

Predator control as a management tool: effects of red fox *(Vulpes vulpes)* control in a Red-legged Partridge (*Alectoris rufa*) population.

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Predator control is applied systematically in many hunting estates in Spain, with the main purpose of increasing the game species populations and, consequently, the bags during the game season. But its effectiveness is not always clear, although it usually implies an important human and time effort. The aim of the present work was to evaluate the effectiveness of selective fox control as a method to improve the survival of Red-legged Partridges (*Alectoris rufa*). The study was carried out during 2008 and 2009 in two hunting estates of Navarra (northern Spain), where two treatment zones were considered depending on the predator control. Red Foxes (*Vulpes vulpes*) were selectively controlled during the first year in one of the zones ("predator control zone", hereinafter PC Zone), while no control was applied in the other zone ("not predator control zone", hereinafter NPC Zone). In 2009, treatments were inverted between zones. We radio-tracked 89 adult partridges in all study areas, which allowed us to locate 45 partridge nests and 31 broods. We captured and radio-equipped 108 partridge chicks of two different ages: 46 chicks few days after hatching and 62 chicks over one-month old. We estimated the effect of predator control on the survival rates of adult partridges, their nests and their chicks using program MARK 4.0. According to Akaike information criterion predator control was not included in the preferred models of adult and nest survival rates. Although predator control was not included in the preferred models explaining survival rates of youngest chicks, estimated survival rate was slightly higher in the PC than in the NPC zones. Contrarily, predator control improved survival rates for one month old chicks, and it was included as a factor of the most preferred models. Consequently, predator control did not improve survival rates for adult and nesting partridges, but it improved chick survival, especially for chicks over one month old.

Poster

Conservation status and hunting management of Red-legged Partridge (*Alectoris rufa*) in the Eastern Province of Genoa (Liguria Region, NW Italy).

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The fulfilment of a spring song census in the years among 2006 and 2011 in two Provincial Conservation Areas (P.C.A.) and the monitoring of the hunting bags carried out during the seasons 2008/2009 and 2009/2010 gave the chance to evaluate the maintenance status of the populations of Red-legged Partridge *(Alectoris rufa),* which are present on the territory at East of Genoa.
From the analysis of data is possible to deduce that in the two P.C.A. the densities of potential nesting pairs present average-low values, with a trend toward a worrying decline. Furthermore the monitoring of the bag put in evidence how the physical condition of the wild specimens is precarious, from the weight point of view, may be due to pour alimentary resources. The examination of data of shot partridges showed also the low return of summer restocking with young individuals as regards the strengthening of natural stocks, so as a major impact of hunting activity against the individuals of feminine sex.
Taking account of the collected data, also considering the marked shooting on the Hunting Regional Cards, is sketched out that the conservation status of the natural populations of Red-legged Partridge is not satisfactory, probably due to the falling of the environmental vocation for the species which characterised the evolution of territory in the last years. Furthermore, it is possible to deduce a low capacity of consolidation and restoration of natural stocks by the introduced individuals, which are also subjected to a stronger hunting pressure.

Poster

Management and monitoring of Red-legged Partridge in the Province of Pisa.

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Small populations of red-legged partridge are present in the Province of Pisa as a result of
reintroductions carried out for hunting purposes.
This two years research is aimed at the evaluation of some survival and behaviour parameters of wild and just-released breeding red-legged partridge and highlight any differences through the use of radio tracking.
Wild red-legged partridge are studied in two "Zona di Rispetto Venatorio" areas where, in February 2011, were captured a total of 26 subjects and fitted with radiocollars.
Breeding red-legged partridge were released in July 2011 in two "Zone di Ripopolamento e Cattura" areas and one "Zona di Rispetto Venatorio", using acclimatization cages. In this case, 30 subjects were fitted with radio collars.
Preliminary results will include:

- analysis and comparison of survival, movements, home range and habitat preferences shown by the two groups of red-legged partridge;
- reproductive success of wild red-legged partridge.

Initiative with the contribution of the Tuscany Region

Poster

Rock Partridge (*Alectoris graeca saxatilis*): hunted animals and reproductive success on the Italian Alps (2006-2010).

ARTUSO I.

Unione Nazionale Cacciatori Zona Alpi (UNCZA)

In the Italian Alps, in the year between 2006 and 2010, 4874 Rock Partridges have been hunted. In the province of Sondrio, there has been the highest number (733 animals which account for 7%) followed by the province of Torino (648 animals), Como (639) and Cuneo (580). The other Italian provinces show lower numbers (less than 500) with the province of Vicenza being the lowest (9 animals). In the region of Lombardia, we have found the highest number of killed animals (2150, 44%) followed by Piemonte (1677, 34%). In these two regions, hunting has been 78.5% of the total number (3827 animals). This leads to conclude that the highest number of Rock Partridges in Italy, is concentrated in the central-Western areas of the alps. In almost all the regions where this animal is present, hunting is allowed. The timing for the hunting season is between October and November. The surveys (in spring and summer) and the environmental recoveries have been allowed for management and safeguarding purposes. In the year 2010, the ration young/adult individuals, has been around 2.15 (minimum was 0.94, collected in the province of Pordenone; maximum was 7.21 collected in the province of Como), the ratio young/brood animals has been 4.35 (minimum was 3.8 in the province of Bolzano, maximum 5.39 in the province of Bergamo). These data have been handed by the provincial Hunting department (Ufficio Caccia Provinciale) and by the Alpine Comprensories (Comprensorio alpino). The study has been promoted by UNCZA.

Lecture

Some recent tools for bird surveys, a fast overview and the example of the French Red-legged Partridge survey.

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Reliable estimates in bird surveys are crucial for many purposes. We may wish to know how many individuals of a bird species are present at a site, or we may need baseline information for a nature reserve. It may be in order to obtain the conservation status assessment of a declining or poorly known population. We might need to undertake an evaluation of the impact of the development on nature conservation value of the land. Often, bird survey data are used to assess whether an area should receive legal protection from governmental agencies. In exploited e.g. hunted species a prediction of population trends may help to maintain the population durably and to set management priorities.
However, one of the most complex problems for a survey program is the variability of abundance estimation e.g. due to variability of vegetation cover among and within the sites, of the observer experience or of different biotic and abiotic factors acting during the count surveys. Therefore, relation of the abundance estimate and population size remains mostly unknown. To obtain such a reliability and comparability of abundance estimates we have to find adapted surveys through measuring detection probability.
Recently, in particular two types of methods came out as mainly adapted in bird surveys at a larger scale: Distance sampling and repeated point count methods, both allowing estimation of detection probability and therefore adjustment of abundance estimates later. Somewhat more complex than working with raw counts, the data treatment of these results allows us to follow changes in bird populations at a larger scale and time period. The two cited methods are applied now in a growing number of surveys of national interest.
The French Red-legged Partridge survey exists since 1992 mainly in the Mediterranean part of France. The applied field technique consisted in a repeated point count transect reinforced by playback, lacking estimation of CI and viable comparability of estimates with other field techniques. From 2009 on, reorganization of field protocols and application of recent statistical tools such as CMR or occupancy models were used to evaluate and adjust the method. Results are encouraging, from now on, we are able to propose a viable model and method, cost / efficient and comparable in space and time. The adaptation of sampling design and the application in other Mediterranean regions might help to render it more user friendly.

Oral communication

Does the use of playback affect the estimates of numbers of Red-legged Partridge *Alectoris rufa*?

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The Red-legged Partridge *Alectoris rufa* is widely distributed with natural populations in Portugal, Spain, Andorra, France and Italy. The IUCN Red List classifies this species in the category LEAST CONCERN that refers to species without conservation threats. In Italy the species lives in a situation of potential conservation risk for its long-term preservation as its habitat is increasingly threatened by the disappearance of traditional agriculture-related environments. In such a situation it is important to use sensitive and appropriate monitoring tools to assess population changes over time and to identify potential conservation threats. The objective of this study was to evaluate the effectiveness of the playback method for estimating the density of calling males. The study area was located in Brignano-Casasco (Alessandria Province – northern Italy), an area of approximately 1.000 ha that is closed for hunting. The census protocol consisted of 4 transects with 8 points each, monitored during three consecutive days. Monitoring started one hour before to one hour after sunrise. We compared the registration of spontaneously calling males at dawn with direct observations. The playback method provided the presence of 9 males. The census at dawn of the spontaneous calls estimated the presence of 25 males while observing the subject from the transect allowed the observation of 17 different pairs. The playback census revealed an underestimation rate of 64%, compared to the method that gave the best results. The coefficient of variation (43.3%) of the playback method was rather high and indicates a low repeatability.
Our study has made a critical evaluation of a method widely used but for which there is little data about its effectiveness. The results raise some doubts about its real capacity to monitor the status of *Alectoris rufa* populations. Indeed a second monitoring session carried out in 2010, whose data are currently analysed and will be ready to be presented at the IUGB Conference, could lead to further interpretations of the census technique effectiveness. The impact of our results on red-legged population management are discussed.

Poster

Census of *Alectoris graeca whitakeri* in the ZPS ITA010029 Monte Cofano, Capo San Vito e Monte Sparagio.

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Population of *Alectoris graeca whitakeri*, an endemic subspecies of Sicily, exhibited a decline in abundance in recent years leading to a contraction and fragmentation of its area. Habitat changes (fires; pasture abandonment), agricultural intensification, excessive hunting pressure, introduction of individuals belonging to other subspecies or species (*Alectoris chukar*) and, likely, recently increased density of *Sus scrofa*, are the factors involved in the current negative status of *Alectoris graeca whitakeri*. For these reasons, harvesting of the species has been forbidden over the last years. According to the conservation actions indicated by the project "LIFE09 NAT/IT/000099–SICALECONS–Urgent actions for the conservation of the *Alectoris graeca whitakeri*", census of the population living in the ZPS ITA010029 Monte Cofano, Capo San Vito e Monte Sparagio (Trapani province) was undertaken. Study area (15524 ha) is a limestone coastal ridge characterized by wide open and rocky habitats with tree species (*Euphorbia dendroides*, *Chamaerops humilis*) and herbaceous species (*Ampelodesmos mauritanicus*). At high altitude, reduced patches with *Quercus ilex* and *Quercus pubescens s.l.* are present and, at low altitude, coniferous reforestation are found. The presence of vineyard, olive grove and cereal crops is scarce. In the majority of the study area hunting activities are forbidden due to the presence of natural reserves and regional properties. Overlapping an UTM grid of 1-km squares on the study area map, 163 squares were obtained. In each of them, *Alectoris graeca* was counted using playback technique. One point per square was performed. Counts were carried out from March to April 2011. The species was recorded in 23 squares and a total of 29 individuals (5 pairs and 19 singing males) were detected. A population of about 60 pairs was estimated for the whole study area.

Poster

Is the Red-legged Partridge (*Alectoris rufa*) naturally colonising the north of Lazio region, Italy?

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The present study aimed to update the distribution of Red-legged Partridge in Central Italy, with particular reference to the north of Lazio Region. As known, the species was introduced in Umbria, Lazio, Molise regions (Brichetti e Fracasso, 2004) and Tuscany (Santilli *et al*., 2005; Spanò, 2010) where it is partially acclimatized. Widespread reports on species presence and reproduction received from the north of the Viterbo province, suggested to put in place a survey. In the years 2010-2011 local people were interviewed (forestry agents, hunters and other reliable sources) and field monitoring was performed (detection of signs of presence and playback survey). All data were collected in a geodatabase of ArcGIS 10.3 (ESRI©).
Signals were georeferenced in a grid of 2752 territorial units (TU), each one with a side of 1 km. Red-legged Partridge were found in 182 TU (18200 ha). Within 31 TU have been detected brigades composed by 6 individuals on average, within 29 breeding pairs and within 97 single birds.
A playback survey schedule was performed throughout spring 2011 in a random sample of cells (27% of the cells in which the presence of the species has been reported) for a total of 118 km line transect. Forty-nine breeding pairs have been estimated in the Viterbo Province. Playback survey confirmed the presence within 25 TU. Because in the province of Viterbo were not performed restocking plans of the species, the distribution detected seems to be caused by the natural expansion of populations from Tuscany and Umbria regions. Further studies are currently in progress to confirm and implement the population parameters.

Poster

Current distribution of Red-legged Partridge (*Alectoris rufa*) in Piedmont: signs of recent territorial expansion.

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The Red-legged Partridge in Piedmont (NW Italy) is historically limited to the hilly and low-mountain areas of the southern half of the region, and in particular lies in the Langhe and the Apennines on the Liguria border, in the districts of Cuneo, Asti and Alessandria. In the Cuneo district, on the Maritime Alps, hybrid populations with *Alectoris graeca* were also known (Martorelli 1913).

The distribution of the species has been mapped in some occasions with the "Atlases" projects of the GPSO (Gruppo Piemontese Studi Ornitologici) (Mingozzi *et al.* 1988, Cucco *et al.*, 1996) and special enquiries (Spanò *et al.* 1986).

On this occasion we tried to update the geographical distribution of the species using data conferred by bird-watchers on the internet site Aves. Piemonte (www.regione.piemonte.it/aves), managed by the GPSO, enquiries among hunters' organizations and specific field researches. The resulting distribution is shown on a 5 km x 5 km grid square map.

The species seems to show signs of distribution dynamism, with the occupation of lowland areas in the Alessandria district, where it was totally absent until the '90s. Smaller nuclei are also present in the Western Monferrato. More stable (or declining) seems to be the situation in the area of the Langhe. In general we are seeing an areal contraction or density reduction on hills and mountains and an extension on lowlands.

The observed changes do not seem attributable only to captive bred and introduced game-birds, but also to environmental and climate changes.

Poster

Eight years monitoring of Rock Partridge *Alectoris graeca saxatilis* in Val Troncea Regional Park.

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In this paper the present the results of an eight-year monitoring of rock partridge *Alectoris graeca* saxatilis in Val Troncea Natural Park (Piedmont, Italy), an high-altitude protected area (1600-3000 m.s.l.) characterised mainly by extensive alpine pasturelands.
To check rock partridge presence and spring density (males / surface) standardised counts have been performed by playback technique since 2004, over an area ranging from 500 to 720 ha. The breeding success (juveniles / adults) was assessed since 2007 during August and September with pointer dogs on a variable sampling area (330-670 ha).
Spring density varied considerably from year to year, in correlation with the winter snow cover, but in general a fall of both the spring density (from 5.5 Km^2 in 2008 to 1.2 Km^2 in 2011) and the breeding success (from 3.6 in 2008 to 0.3 in 2011) was registered, meaning the population has been declining rapidly.
To improve the evaluation of actual monitored range and assess the research effort, 6 GPS dog tracking systems were used during summer 2011. This novel technique appears to be a great improvement in wildlife management.

Lecture

The importance of regional collaboration in the Mediterranean Basin for biodiversity conservation.

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While many conservation programs are applied at national and sub-national scales, the importance of global and regional in conservation coordination is growing. Increasingly, both governmental and non-governmental organization spend resources outside their country of origin, reflecting an internationalization trend in conservation. International programs are often costly, complicated and require additional logistics and resources compared to local programs. Given the need to maximize returns on investment within the very limited conservation budget, it is therefore crucial to quantify how much more biodiversity can be protected by coordinating multi-national conservation efforts when resources are fungible. Previous studies that compared different scales of conservation decision making addressed variability in biodiversity measures, but ignored spatial variability in the threats to biodiversity and the cost of actions. Here, we developed a simple integrating metric, the biodiversity-human impact metric (BHM), which enabled us to take into account both threats to biodiversity and the cost of conservation. We focused on the Mediterranean Basin, one of Earth's richest biodiversity hotspot, which encompasses over 20 countries. Using the Marxan decision support tool, we discovered that, for freshwater fish, amphibians and reptiles, in order to achieve the same conservation benefits, one would need substantially more money and a larger area for conservation if each country acts independently compared with coordinated action across the whole Mediterranean Basin. The initiative declared in the 2008 Paris Summit for the Mediterranean may form a basis for this complex coordination. However, because most conservation priority areas selected for these vertebrates were located in European Union (EU) Mediterranean countries, a partly coordinated solution incorporating only the EU countries was almost as efficient as the fully coordinated scenario across the whole Mediterranean Basin. As such, it can provide an efficient compromise until a fully coordinated plan is feasible.

Oral communication

Status of rock partridge (*Alectoris graeca saxatilis*) populations along the western Alps : output of an Alcotra programme.

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Alpine rock partridge is a game species with a southern European distribution. It is of special conservation concern by living in high altitude areas subjected to harsh weather conditions, to habitat loss due to abandonment of agricultural practices and also to disturbance due to leisure activities. Listed in the Bird Directive (2009/147/EC), its effective conservation requires international co-operation. Therefore in 2009 started the ALCOTRA transfrontier programme "I galliformi alpini/les Galliformes alpins" involving Regione Piemonte, Regione Valle d'Aosta and CNR in Italy and ONCFS in France. Its main aim was to join methodologies of census and population dynamics, hunting management and measures of impact of human activities. Our presentation will focus on the status of rock partridge known from monitoring species abundance and distribution along the western Alps area. Monitoring data were collected at a variety of scales (site scale, administrative unit, geographical unit, western Alps area).Our results show that the distribution and density have much changed over time: population exhibited large fluctuations in numbers since 3 decades and also important changes in distribution areas. We discuss some of the challenges presented by current monitoring in the various alpine regions. The implementation of a transfrontier monitoring framework would make sense for conservation purposes because most of the threats (habitat loss, climate change) tend to operate at large scales.

Oral communication

Comparison of predictive and descriptive models in order to plan.the monitoring and research on the rock partridge (*Alectoris graeca*) in the north eastern Alps.

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Within the implementation of the Management Plan for the Alpi Carniche region (SPA IT3321001, SCI IT3320001, SCI IT3320002, SCI IT3320003, SCI IT3320004) and the realization of the monitoring plan referred to art. 8 of RL No. 7/2008 (Friuli Venezia Giulia) some predictive and descriptive models for the presence and abundance of rock partridge *Alectoris graeca saxatilis* have been developed and tested. During 2010 the monitoring plan has been carried out during the spring (play-back censuses) and the summer (pointing dog censuses) in 10 sample areas to assess the presence, abundance and reproductive success of the species. These areas have been identified through expert knowledge and predictive models developed by the superimposition on regional UTM 1x1 kilometer grid quadrants of some CORINE Biotopes habitat parameters (open vegetation coverage >50% and open + transitional vegetation coverage >80%) and slope (>10%) and elevation (1000-2200 m above sea level), subsequently ranked from 0 to 4 for a suitability index. The census results related to UTM quadrants (n = 46, 40% with the presence of partridges) and buffer areas (100 meters of radius) created from the locations of the observed animals and the transect points of the censuses (n = 89) have been described by linear selection models that contain habitat classes from the Habitat Map of Friuli Venezia Giulia (Map of the Nature at the scale 1:50.000, ISPRA 2009) and morphological characteristics such as slope, elevation and aspect. The descriptive models have selected different variables according to the season (reproductive and post-reproductive), identifying the presence of Eastern Alpine calcicolous larch with moorland as one of the most important variables to define habitat suitability. Moreover, the descriptive models that use the lesser spatial scale (100 m buffer) seemed to describe better the presence and abundance of this species. The predictive models however were inappropriate to describe the presence of this species and should be used with caution to plan the monitoring activities. The research was supported by the Friuli Venezia Giulia Autonomous Region.

Poster

LIFE09 NAT/IT/000099 project in Sicily: "Urgent actions for the conservation of the *Alectoris graeca whitakeri*".

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The Sicilian Rock Partridge, *Alectoris graeca whitakeri*, is an endemic subspecies breeding in Sicily. During the nineteenth century, the population of this taxon was widespread, but recently its geographical distribution has been changing showing fragmentation and densities decreasing. The causes of the decline are habitat modifications, agricultural mechanization, and massive use of biocides, fires, poaching and the reintroduction of wild boar, *Sus scrofa*. *Sus scrofa* was an extinct species in Sicily at the end of '900 but it has been reintroduced about thirty years ago. The genetic pollution is considered also a threat due to the illegal introduction of specimens belonging to other subspecies or species *Alectoris*. Hence, Sicilian Rock Partridge has been included in the Directive 79/409/EEC (Annex I) and in the Directive 2009/147/EC. To stop the species decline, precise actions concerning the conservation of the local popolation has started during the 2010 within projects as the SPA "ITA010029 Monte Cofano, Capo San Vito e Monte Sparagio ", with the financial support of LIFEplus (LIFE09 NAT/IT/000099). These activities have to be completed by 2013. During the period from 2010 to 2011 the main aims were i) to verify the genetic integrity of the Sicilian rock partridge population; ii) the census of the partridges individuals within SPA areas; iii) the census of the wild boar individuals; this kind of information permits numerical control, a better environmental space planning, aviaries breeding for restocking and local reintroduction. An additional important aim was also to create local human populations awareness of the importance of this species.

Poster

Viability analyses (PVA) of Barbary partridges (*Alectoris barbara*) in Sardinia Island.

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The Barbary partridge is widespread across North Africa, where it occurs from the coastal plains to the Atlas Mountains and edges of the Sahara. The species is distributed on the Rock of Gibraltar, where has spread to adjacent Spanish mainland, in Canary Islands and in Sardinia Island.
We monitored partridge population in eight study areas of Sardinia Island during 2009 and 2010 in order to assess population viability and to individuate the key demographic parameters which improvement can lead to the population survival. Partridge pre-breeding density was estimated in all study areas, while partridge population was monitored by pre and post-breeding censuses in two study areas, where demographic parameters were assessed. Demographic parameters were used to run Population Viability Analysis by mean of a software for the stochastic simulation of the extinction process (Vortex 9.99b). Simulations were conducted both using average values of demographic parameters and varying values in accord with the trend showed in the study period or with the effects of hypothetical management options, improving by 5% the value of demographic parameters. Variables that were modified in the different scenarios were: pre-breeding density (low, medium, high), size of study areas, carrying capacity, chick survival rate, adult survival rate, brood production rate, and average brood size.
Our results showed the improvement of both brood production rate and adult mortality can enhance partridge population survival within the next 20 years, apart from the size of study areas and pre-breeding density. However, the improvement of both demographic parameters could ensure partridge persistence within the next 20 years only for population at high density (40 partridges / km^2 at least).

Poster

Sicilian Rock partridge (*Alectoris graeca whitakeri*): is the current protected area network enough?

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Over hunting, poaching, restocking, habitat losses, and wrong management decisions are the most important causes of the decline of rock partridge in its whole range in Italy. In Sicily the decline started from 1950's and it was amplified by changes and mechanization in agricultural techniques, large employment of herbicides and pesticides, enlargement of road network, fires and arsons. Habitat suitability models are one of the most important tools to plan correct management actions. Our goal was to investigate the protected area network in Sicily in order to evaluate if the current situation is appropriate for the conservation of the species. The study was conducted at a regional-scale, starting from 258 presence data collected between 2003 and 2009. We developed different suitability models for Sicilian Rock Partridge using as predictor variables the land use (from Corine land cover), altitude, exposure and slope (from digital terrain model). We followed three different presence / availability approaches. 1) Logistic Regression Models with multi-model inference: we used 224 presence cells and 224 random cells. We selected different models both by Akaike Information Criterion (AIC) and by stepwise method. Each model was validated by 2-Fold cross validation and its performance was evaluated by chi-square and ROC curve analyses; furthermore we performed a Spearman rank correlation analysis between the frequency of true positive cases and the probabilities predicted by the model. 2) Ecological Niche Factor Analysis (ENFA). 3) Maximum Entropy Modeling (MaxEnt). We used all the models to classify the whole Sicily territory, so to obtain the mean probability of rock partridge presence for each cell and the potential distribution map of the species. Finally we overlapped the potential distribution map to the protected areas map and we calculated which percentage of suitable territory lies in protected zones.