Special Review

Italian review of Doctoral theses in Ornithology

Edited by Michelangelo Morganti[1,2]

[1] *Associate editor of Avocetta, avocetta.mm@gmail.com*
[2] *Dipartimento STEBICEF, Università degli Studi di Palermo, Via Archirafi 18, 90123, Palermo, Italy. www.labzea.it*

Introductory note

For the first time in Italy, Avocetta collected the abstracts of some of the Doctoral theses focused on Ornithology and defended in Italian Universities between 2010-2011 and 2014-2015 academic years. The aim of this collection is to offer a review of the research lines on which Italian ornithology is actually working and to offer visibility to researchers who with their doctorates contribute to the development of this scientific field.

In this first review, 10 theses were received belonging to six Universities. Overall, the theses spread over six major topics, not mutually exclusive: migration ecology (3), reproductive biology (3), biodiversity and conservation (3), climate change effects (2), evolution (2), sexual selection (1).

Five theses are structured as a series of experiments on a unique model species, while the rest consider altogether a set of species sharing common traits. The majority of the theses present results from field-collected data, while in one case results mainly comes from genetic analyses. The most of the chapters of them are already available as published papers, in which case are indicated in the reference list at the end of the review. When the full pdf file of a thesis is available, the appropriate link is indicated at the end of the abstract. Theses are presented in alphabetical order following the name of University and of the doctoral candidate surname. Contents of the abstract are not reviewed and are responsibility of the authors.

Nota Introduttiva

Per la prima volta in Italia, Avocetta ha riunito gli abstracts di alcune delle tesi di dottorato di argomento ornitologico e discusse nelle Università Italiane tra gli anni accademici 2010-2011 e 2014-2015. L'obbiettivo di questa raccolta è quello di offrire uno spaccato delle linee di ricerca attorno a cui si sta sviluppando l'ornitologia italiana e di offrire visibilità ai ricercatori che con il loro lavoro di dottorato contribuiscono allo sviluppo di questo campo della ricerca scientifica.

In questa prima raccolta si sono ricevute 10 tesi procedenti da sei diverse Università. Nel complesso, le tesi affrontano sei grandi argomenti, in maniera non esclusiva: ecologia della migrazione (3 tesi), biologia riproduttiva (3), biodiversità e conservazione (3), effetti del cambiamento climatico (2), evoluzione (2), selezione sessuale (1).

Cinque tesi sono strutturate come una serie di esperimenti attorno ad un'unica specie modello, mentre le restanti considerano nei loro studi un gruppo di specie con determinate caratteristiche in comune. La maggior parte delle tesi presenta risultati procedenti da dati raccolti direttamente sul campo, mentre in un caso i risultati sono principalmente ottenuti attraverso test genetici. La maggior parte dei capitoli delle tesi qui presentate sono già pubblicati come lavori scientifici indipendenti, nel qual caso sono indicati nella lista bibliografica alla fine della raccolta. Le tesi sono presentate in ordine alfabetico seguendo il nome dell'Università e quindi il cognome del dottorando. Il contenuto degli abstracts non è stato oggetto di revisione ed è di piena responsabilità dei singoli autori.

LIST OF THE ABSTRACTS

Università La Sapienza - Rome

Thesis 1

Bird community analysis: standardization and application of a management instrument

L'analisi della comunità ornitica, standardizzazione e applicazioni di uno strumento di gestione

Author: **Roberto Isotti**, wildlife@homoambiens.com
Supervisors: Prof. Alberto Fanfani, Prof. Marina Cobolli.
Academic Year: 2010-2011.

Abstract
The aims of this thesis were to:
1) Standardize and validate the line-transect method for the assessment and mapping of protected areas. A protocol, obtained by the evaluation of the relationship between reliability of the results and work effort, would allow the comparison of the studies;
2) To contribute to the knowledge of fragmentation, on both phenological cluster structures and bird community structures (Circeo National Park and Castelporziano, Latium).

Analyses
1) Validation of the method, we evaluate if:
a) Analyses to determine if the reliability of the results was affected by the choice of grouping habitats. To determine the information loss for independent transects, transects grouped by habitat and habitat pairs of transects (randomly paired), we evaluated qualitative data, quantitative data and diversity index.

Analyzes suggests that the qualitative and data quantitative should not be overlapped to the habitat information. Instead, using the Shannon diversity index, the results allow the overlapping;
b) The reliability of results is affected by the choice, in data collecting, of: n. of transects; n. of transects/habitat; the repeat for more years. So the n. of working days and/or the n. of operators for data collection (economic efforts required to the aim).

Analysis confirms that it is always necessary to consider the size of the study area (to determine the min. tot. n. of transects needed) and the habitats heterogeneity (the repeats of data collection in a habitat depends on its characteristics). However, to have reliable data sets to the management of Mediterranean area, it is essential to carry out studies of minimum 3 years.

2) Fragmentation, analyses were carried out to:
a) Quantify the change in the structure of 3 types of phenological groups of birds, which occur in 2 Mediterranean habitats (small wetlands and oak trees) using analysis of the relationship between diversity and dominance. The wetland assemblages showed a lower structuring of breeding communities, while clusters of oak trees showed less structuring for wintering species. Comparing the phenological groups of the 2 habitat types, only breeding species showed no significant differences in the slopes. Comparing the 3 phenological assemblages within each habitat, emerged significant differences in the small-sized wetlands, not in the oak forests. Our data suggest that the period associated with the habitat type could be considered an important factor in the structure of the bird populations. The small Mediterranean wetlands are characterized by high seasonal structural changes in the availability of resources and niches (e.g. water stress, floods, droughts), more than in forest habitats. This allows the coexistence of a large number of individuals and species and has a decisive influence on the assemblages. During the spring, breeding species are less represented in small wetlands compared to oaks, due to the vegetation less layering and complexity. In contrast, the oaks are poor in environment resources and less dynamic in winter. In this condition only the generalist and sedentary species can thrive;
b) Determine the community structure in a set of natural habitats. Castelporziano presents a complex ecosystem, consisting of a mosaic of habitats and their ecotones, with a high diversity. Wetlands hosted the largest number of species, followed by oak trees. The community of Castelporziano is characterized by a high complexity and richness. The null-model analysis reveals that the community is not structured randomly. Instead, Circeo shows a greater autonomy of the communities of different habitats, placed in a less heterogeneous mosaic. However, at seasonal level, a significant change is showed in the relative weight of habitats. The results bring a contribution to the analysis of the conservation level of Mediterranean habitats and suggest a different approach to the phenomenon of fragmentation, where the natural quality of each patch of the mosaic environment should be estimated, through the use of appropriate analytical tools.

Pdf of the thesis is available at:
http://padis.uniroma1.it/

Università degli Studi della Calabria - Cosenza

Thesis 2

Effect of climate changes on female reproductive fitness in Rock sparrow *Petronia petronia* (Aves, Passeridae) breeding in the Western Alps
Effetti dei cambiamenti climatici sulla fitness riproduttiva di femmine di Passera Lagia *Petronia petronia* (Aves, Passeridae) nidificanti sulle Alpi occidentali

Author: **Pierpaolo Storino**, pierpaolo.storino@gmail.com
Supervisor: Prof. Maria Carmela Cerra.
Academic Year: 2014-2015.

Abstract
Climate change has pervasive effects on bird populations, especially on their life history traits, like geographic range, egg-laying dates, fledging success and clutch size. Alpine and arctic ecosystems represent excellent models to study these effects as they are sensitive to climate change showing marked oscillations following climate perturbations. The Rock sparrow *Petronia petronia* is a loosely colonial and cavity nesting passerine, distributed from Southern Europe to Central Asia, in open habitats under dry and sunny climatic conditions.

A marginal population in the Italian Cottian Alps (Upper Susa Valley), between 1,550 and 1,800 m a.s.l., was chosen for a long term study (1991-2013) on the relation between weather condition, phenology and reproductive success. The breeding population was studied using 40-50 artificial nest boxes/year and individual tagging of adults (n = 207) and fledglings (n = 2,469). We measured reproductive and phenology population parameters (laying, brooding, and fledging dates, n. clutches, n. fledged juv/season per female) and proxies of climate conditions (air temperature, rainfall) to explore associations between population parameters and climate change.

For the last 2 breeding seasons (2012-2013) both a non-invasive method to determine endogenous stress hormone levels in adult feathers and a measure of immunocompetence (T-cell-mediated immune response, CMI, towards the mitogen phytohemagglutinin, PHA) of nestlings, were used to demonstrate how climatic variations may favour individual fitness acting on individual quality and survival.

We detected a significant advance (6 days) of clutch initiation associated with warmer seasons, a significant increase in the frequency of females that nested twice in a season, contemporary to an almost significant advance of the second deposition as well. We also detected a significant trend in the fledging success of the second depositions, but not of the first ones. Thus reproductive success of Rock Sparrow was positively related to increasing air temperature during the nestling period.

We did not found any association between climatic variations and individual quality or survival, but we identified a positive association between the body condition index (BCI) of females and fledglings, and between the body mass of fledglings and their immunocompetence. CORT levels were negatively correlated with female and fledgling BCI, but not with CMI of fledglings. Thus, while the rapidity of change of the reproductive performance suggests that the observed responses to climatic variations are more likely explained by phenotypic plasticity, elevated baseline CORT levels signal individuals in poorer condition, and suggest a critical influence of glucocorticoid on essential metabolic and energy-allocation processes (or fitness proxies), consequently affecting individual fitness.

Università di Milano Bicocca – Milan

Thesis 3

Analysis of the consequences of climate change and habitat modification on migratory birds
Analisi delle conseguenze dei cambiamenti climatici e delle modificazioni dell'habitat sugli uccelli migratori

Author: **Beatrice Sicurella**, beatrice.sicurella@gmail.com
Supervisor: Prof. Roberto Ambrosini.
Academic Year: 2013-2014.

Abstract
Habitat alteration and climate change are among the most important factors that are contributing to the global decline of biodiversity. Due to their sensitivity to environmental conditions, birds are considered excellent indicators of global change, and in particular long-distance migrants, because they experience divergent patterns of change in their breeding and wintering quarters.

In this thesis we investigated the effects of environmental change on population dynamics of long-distance migrants.

First, we observed that the presence of livestock farming and the extent of hayfields near the breeding site affected colony size of Barn Swallows *Hirundo rustica* in Northern Italy, and that recent variation in these conditions has worsened the demographic decline that this population is experiencing.

We also investigated the effect of the rearing environment on the survival and growth of Common Swift *Apus apus* nestlings and we observed that their growth is influenced by competition for resources with nest mates and meteorological conditions. The effects we documented were different from those observed in other parts of the breeding range, suggesting geographical variation in the susceptibility of this species to ecological conditions.

Afterwards, we identified migration routes and wintering quarters of small-sized birds, and we evaluated the effects of environmental conditions experienced during migration and wintering on population dynamic. We used the large number of ring recoveries available for the Barn Swallows to identify the main migration routes of individuals breeding in Europe and we applied miniaturized tracking devices to more than 100 individuals breeding in

Northern Italy. The data we collected allowed us also to evaluate the impact of these instruments on survival and breeding success of individuals and to obtain information on timing of migration and position of the wintering areas. Later, we combined this information with long-term data on population dynamic and found that environmental conditions encountered during wintering and spring migration most influence year to year variation in population size. Finally, we analyzed ringing data on the European Robin *Erithacus rubecula* and found that winter temperatures at the breeding grounds influenced spatial and temporal variation in migration propensity and distance among individuals.

Overall, our studies confirmed that environmental change is affecting birds at different stages of their life-cycle. We showed that variations in ecological conditions at breeding quarters influence breeding performances, while conditions experienced during migration and wintering affect survival. Effective conservation measures for migratory species should therefore aim at protecting both breeding, wintering and stopover sites.

Pdf of the thesis is available at:
https://boa.unimib.it/handle/10281/69740

Università degli Studi di Padova - Padua

Thesis 4

Condition dependence of sexually selected signals in the European Starling *Sturnus vulgaris*
Condizione dipendenza dei segnali selezionati sessualmente in Storno *Sturnus vulgaris*

Author: **Simone Pirrello** simone.pirrello@gmail.com
Supervisor: Prof. Augusto Pilastro.
Academic Year: 2014-2015.

Abstract
Since Darwin, evolutionary biologists envisaged various hypotheses to explain the advantages for males to exhibit exaggerated secondary sexual traits, also known as ornaments.

The evolutionary scenario becomes more complex if we consider that in many species males bear multiple ornaments.

In my Doctoral project, I used a passerine bird, the European starling *Sturnus vulgaris*, as model species given that males bear multiple secondary sexual traits. I attempted to investigate the mechanisms that underlie the expression of male ornaments by experimentally manipulating individual condition during two energy-demanding life-history events, i.e. during the nestling development and during the post-juvenile moult.

The first experimental manipulation aimed at investigating the effect of an immune challenge on growth and physiological responses on nestlings that were naturally infested with ectoparasites, and to assess the temporal pattern of their first- and second-year moult.

The second experimental manipulation was used to test the effect of removing the stress caused by the nest ectoparasites on parental investment during the incubation, and on parent-offspring communication during the nestling stage. I then examined the temporal pattern of the post-juvenile moult in males from ectoparasite-free and naturally infested nests.

A third experimental manipulation consisted of supplementing with or depriving of carotenoids the diet of males in the course of their post-juvenile moult. I further tested the effects of nest ectoparasites and diet i) on the preening activity of males during winter, ii) on the expression of male ornaments and iii) on the female preference.

My results suggest that an early stress, i.e. endotoxin or ectoparasites, does not significantly affect the nestling growth. Nestlings in ectoparasite-free nests produced a more conspicuous postural begging than that produced by nestlings in naturally infested nests. Parents were also sensitive to nest ectoparasites because they increased the time spent at the nest during the incubation period, although the provisioning effort during the nestling period was not different between deparasitized and control broods. Moult was advanced in birds injected with LPS and in those grown without nest ectoparasites, as they were probably in better condition than their counterparts and could therefore anticipate such costly life-history event.

Birds from ectoparasite-free nests moulted over a longer period than controls, whereas moult duration of LPS and control birds was similar. Birds supplemented with carotenoids during moult increased the time invested in preening, and showed beak with high ultraviolet and yellow brightness in the following breeding season.

The males that were grown in ectoparasite-free nests and were supplemented with carotenoids during the following moult were preferred by the females in the mate choice experiment.

In conclusion, the results of my Doctoral project provided an experimental evidence of carry-over effects in starlings. As result, males that experienced different stresses during the early stages of their life were less attractive for the females in their first breeding season.

Università degli Studi di Pavia - Pavia

Thesis 5

Hotspots and coldspots of bird diversity in central Apulia (Southern Italy)
Hotspots e coldspots di biodiversità ornitica nella Puglia centrale (Italia meridionale)

Author: **Gianpasquale Chiatante** harrier84@libero.it
Supervisor: Prof. Giuseppe Bogliani.
Academic Year: 2014-2015.

Abstract
Nowadays we can assist to the largest crisis of biodiversity loss after the dinosaurs' extinction. To conserve the biodiversity it is essential plans protected areas following a prioritization approach, which take in account the real biodiversity value of the places. The main aim of this research was to identify the hotspots and the coldspots of bird diversity in the provinces of Barletta-Andria-Trani and Bari, in Central Apulia (Southern Italy), and to compare their distribution with the protected areas network. To define the hotspots of bird diversity a scoring method was used, defining a biodiversity value for each cell of a 1km grid cell superimposed on the study area. This value was defined as the sum of four parameters: the species richness, the rarity index, the vulnerability index, and the combined index. The species richness was assessed by the species occurrences collected by the fieldwork. Data collection was realized following a stratified random sampling, with strata defined by the land use cover. To define the spatial distribution of the species in the location where data were not enough, habitat suitability models were realized by the binary logistic regression analysis (using GAM and the Multimodel Inference) and by the geostatistics (semivariance and Indicator Kriging). The hotspots and the coldspots of the study area were defined as the 15% of the cells with the higher/lower value of biodiversity. A binary logistic regression was built to understand the relation between the hotspots and the land use cover. Finally the GAP analysis was used to compare them with the current network of protected areas.

This study showed that the winter hotspots were associated with orchards, irrigated crops, urban areas, and vineyards, whilst the breeding hotspots were associated with more natural areas (shrublands, woodlands, wetlands) such as with open areas (natural grasslands, irrigated and not irrigated crops). This research highlights the importance of farmland areas mainly for wintering species, and the importance of open areas for breeding species. An important result showed that the hotspots for the breeding species cannot used as a surrogate for the wintering species, which were often not considered when a protected areas could be defined.

Thesis 6

Reproductive biology of Crab Plover *Dromas ardeola* in Eritrea
Biologia riproduttiva della Droma *Dromas ardeola* in Eritrea

Author: **Giuseppe de Marchi** dromasardeola@gmail.com
Supervisors: Prof. Mauro Fasola, Prof. Paolo Galeotti.
Academic Year: 2012-2013.

Abstract
Aim of the study was to shed light on the breeding biology of a still little known shorebird that nests on desert islands in the north-western Indian Ocean, the Crab Plover *Dromas ardeola*. It is unique or unusual among the shorebirds for its underground nests, for its colonial breeding, for the huge size of the egg, for the low incubation constancy, for the long post fledging care of the young. How these breeding adaptations are interrelated was largely unknown.

Data have been collected during five expeditions to Eritrea during the years 2011-2013. A collaboration with Iranian researchers has provided additional data.

We used molecular and behavioural sexing in order to have a large set of morphometric data on adults of both sexes captured with an improved model of noose trap triggered at the burrow entrances. Discriminant analyses showed that crab plovers can be sexed efficiently with the size of the bill. Data from Iran allowed for the first time to measure the chick development and discovered the very low weight of fledglings compared to adults, a likely sign of a strong intraspecific competition for food due to colonial life.

The use of GPS tracking, dummy eggs and videorecording confirmed that Crab Plovers have a low incubation constancy (less than 55%) due to unexpectedly long foraging trips and to a highly intermittent rhythm of incubation with an average of five incubation bouts/hour, which result in long nest desertions. However, the study of the time budget showed that the low incubation constancy is not dependent on compelling foraging need but is explained by the extraordinary thermal properties of the burrows that allow a partial solar incubation. The factors that might precisely time the summer breeding season were up to now unstudied and considered a puzzle. In fact, the sum-

mer breeding season turned out to be favoured by a wide set of environmental conditions; rainfall, temperature, food availability, abundance of Palearctic predators and competitors. However, only marine chlorophyll concentration around colonies, a proximate of food abundance, was correlated with the breeding season throughout the breeding range, pointing to the critical role of food abundance for the timing of the breeding season.

Last, the possible interrelations between the breeding adaptations of the species were analysed in light of the new discoveries.

Thesis 7

Across and around a barrier: migration ecology of raptors in the Mediterranean basin
Attraverso ed attorno ad una barriera: ecologia della migrazione dei rapaci nel bacino del Mediterraneo

Author: **Michele Panuccio** panucciomichele@gmail.com
Supervisor: Prof. Giuseppe Bogliani.
Academic Year: 2012-2013.

Abstract
This thesis analyzes and compares the migratory behavior of four raptor species: Short-toed Snake Eagle *Circaetus gallicus*, European Honey Buzzard *Pernis apivorus*, Western Marsh Harrier *Circus aeruginosus* and Black Kite *Milvus migrans*.

Fieldwork was carried out in Italy and Greece through visual observations at different watch sites, including areas (i.e. Mount Olympus) from which there were no available information. Moreover were also analyzed ring recoveries of Western Marsh Harriers ringed during the breeding season in Europe and recovered during winter both in Europe and in Africa. In addition, it was created a model to explain the distribution of Short-Toed Snake Eagles in Italy using data on their nest localization. Taken together, the collected information show that the four studied species perform different migration strategies to overcome the barrier represented by the Mediterranean Sea. Short-toed Snake Eagles breeding in Greece, similarly to those breeding in Italy, perform a long detour. Individuals from the Balkan peninsula concentrate at the Bosphorus while those breeding in Italy cross the sea at the Strait of Gibraltar. This strategy implies information transmission between experienced (adults) and inexperienced (juveniles) individuals migrating together in mixed-age flocks thanks also to a partial overlap in the departure dates of migration. Through the integration of information from movement ecology, geography and traditional ecological features it was provided an ecological explanation of the current biogeographical pattern of Short-toed Snake Eagles suggesting that the abundance of this species increases with latitude despite the existence of large areas of suitable habitat in Southern Italy. This result can be explained considering that the actual distribution of this species is influenced by the used flyway, supporting the hypothesis that eagles are still colonizing Italy through an unexpected colonization direction from north to south. Among the studied species, the Western Marsh Harriers is the one showing the broader front of migration over Sea, moving along parallel flyways across the Mediterranean.

Ring recovery analysis, related to 320 Western Marsh Harriers, shows that this species performs a leap-frog migration with individuals breeding further north and east migrating further south during winter, up to south-Saharan Africa. European Honey Buzzards and Black Kites show intermediate behaviors between the two previous species. They migrate across the Mediterranean but concentrating at islands and Straits such as over the Channel of Sicily. Both species show a higher tendency to migrate over sea during spring migration than during autumn, minimizing time before the reproductive season and minimizing risk after that.

The thesis is based on published papers all available at: www.raptormigration.org

Università degli Studi di Pisa - Pisa

Thesis 8

Adaptive strategies of the Eurasian Stone Curlew *Burhinus oedicnemus* nesting in river habitat
Strategie adattative dell'occhione *Burhinus oedicnemus* in ambiente fluviale

Author: **Chiara Caccamo** chiara.caccamo@gmail.com
Supervisor: Prof. Emilio Baldaccini.
Academic Year: 2010-2011.

Abstract
The Eurasian stone curlew *Burhinus oedicnemus* is classified as a species of conservation concern in Europe, mainly due to its population decline which has been caused by the loss and fragmentation of reproductive habitat. Current availability of detailed information on its biology is quite poor and is mostly limited to studies on English populations; these breed on the northern edge of the European range and use quite different habitats from the Mediterranean populations.

The aim of this thesis was to investigate some aspects of the ecology and behaviour of stone curlews breeding in a poorly known habitat, i.e. river, which is an important breeding habitat for Italian populations. In particular, the stone curlew population nesting in the Parco Regionale Fluviale del Taro (Parma, Italy) was studied; this area hosts one of the largest populations in continental Italy. Hatching success, moult strategies during the breeding season and the spatial behaviour of the species were all investigated.

Since the study population primarily breeds in the riverbed, the influence of the river dynamic on hatching success was examined. Nests were monitored periodically, *inter alia*, using temperature loggers, which limited disturbance by significantly reducing the number of visits. Furthermore, the availability of data on the precise failure date of nests improved the estimates of survival rate and provided some useful insights into the possible causes of failure. Parameters such as mean temperature and the amount of rainfall during the breeding season did not have any effect on hatching success. However, nest survival was lower in years not preceded by significant autumn-winter river flows. This suggests that hatching success could be at least partially related to the river dynamic, which determines the characteristics of nest sites by removing vegetation on the riverbed and by reshaping the river course. The open habitat around nests could limit predation risk, by increasing the detection probability of terrestrial predators and by reducing the number of perches used by corvids to prey on eggs.

One of the most interesting aspects regarding moult strategies was the extensive overlap between the moult and breeding season.

Primary moult in the study population was very slow, starting at the beginning of the breeding season (May) and ending in October. Secondary moult was much more irregular and, even though it started when birds were still nesting, most of the secondaries were replaced during the post-reproductive period. Secondary moult was not completed within a single moult cycle: innermost and outermost secondaries were more likely to be shed than those at the centre of this tract and juvenile secondaries were not shed during the first year. On the whole, the observed combination of early commencement of wing moult and extensive overlap between moult and the breeding season is relatively uncommon among waders and, more generally, among other avian species breeding in temperate regions. This could be interpreted as a strategy to maximize hatching success (which was quite low in the study area) through re-nesting potential, i.e. by spreading the cost of moult over a prolonged time period.

The results of a comparative analysis performed among wader species of the Palaearctic area were consistent with this hypothesis: species with a prolonged breeding season also showed considerable overlap between moult and the breeding season.

In relation to stone curlew spatial behaviour, attention was focused on the analysis of the environmental features that influence the bird's feeding choice and on the interaction between birds and human activities (chiefly agricultural) in the study area. During the day birds concentrated their activity almost exclusively in the riverbed, whilst at night they regularly commuted from breeding sites to feeding areas (mostly farmland) a few kilometres away. In these areas, stone curlews showed a clear preference for recently mown crops (mainly forage and wheat) and piles of farmyard manure. Habitat preference is closely linked to the predominant agricultural activity of the study area, namely a high density of farms producing 'Parmigiano-Reggiano'. This provides a wide range of suitable foraging sites close to nesting territories. The ability of stone curlew to breed successfully in fairly intensive farmland, could help to explain the high density of breeding pairs recorded in the study area. We propose that the conservation of stone curlew in this habitat could potentially be achieved only by a synergistic management of both natural and agricultural habitats.

Thesis 9

Molecular evolution and conservation genetics of galliforms: the Black Francolin *Francolinus francolinus* and the Red-legged Partridge *Alectoris rufa*

Evoluzione molecolare e genetica della conservazione dei galliformi: il francolino nero *Francolinus francolinus* e la pernice rossa *Alectoris rufa*

Author: **Giovanni Forcina** forcina.giovanni@libero.it
Supervisor: Prof. Roberto Lorenzi.
Academic Year: 2013-2014.

Abstract

This study attempted to gain genetic information to the adaptive conservation of two Palaearctic taxa deserving evolutionary and conservation interest, the black francolin *Francolinus francolinus* and the red-legged partridge *Alectoris rufa* (Galliformes). Noteworthy, the latter suffers from biotic homogenisation and hybridisation with the chukar partridge *A. chukar*.

The evolutionary history of *F. francolinus* was investigated by amplifying the mitochondrial DNA (mtDNA) Control Region (CR) gene (*ca*. 1170 bp), a set of micros-

atellites providing further information. Moreover, the species' phylogeography was updated by genotyping modern (n = 205) and ancient (n = 76: 1834-1967) birds at a 185-bp long CR fragment. The phylogenetic reconstructions supported the monophyly of the "spotted" francolins and that of the entire group. The Indian sub-continent was evidenced as the ancestral area for the westward adaptive radiation of *F. francolinus* and a strong phylogeographic structure was found, with the six morphological subspecies arranged into three mtDNA clusters. Molecular evidence for a human-mediated introduction from Turkey to Cyprus was found, while the alleged introductions from Cyprus to Sicily and from the latter to Tuscany definitely proved. The mixed genetic origin of the extinct Sicilian population was disclosed, some representatives displaying an overt genetic affinity to southern Asian conspecifics. The same affiliation emerged for an ancient bird from Spain, crediting the invoked importation from Sicily into the latter. The occurrence of genetically isolated wild district populations deserving separate management was evidenced in Cyprus, while the assignment of captive birds to Asian subspecies pointed to genetic pollution as a further threat.

Moreover, the first genetic survey of the introduced-to-UK *A. rufa* was carried out. Specifically, an East Anglian population (n = 58) was genotyped at 1092 bp of the mtDNA Cytochrome-*b* (Cyt-*b*) gene and a panel of microsatellites, four species-specific *A. rufa* x *A. chukar* Random Amplified Polymorphic DNA markers providing further insights into the genetic integrity. English *A. rufa* museum specimens (n = 13: 1824-1915) were characterised at a 229-bp long Cyt-*b* fragment. A tight genetic affinity of historical and modern East Anglian birds with *A. r. rufa* from the easternmost part of the range emerged. Overall, an increase of diversity and decline of disparity over time within and among *A. rufa* populations were evidenced, respectively. Whereas no evidence of *A. chukar* mixed maternal ancestry was found in the ancient birds, introgression in modern ones was widespread, pointing to the loss of the high conservation value of this resource.

Thesis 10

Migratory behaviour and genetic variation in Western populations of the Stone curlew *Burhinus oedicnemus* (Charadriiformes, Burhinidae)

Comportamento migratorio e variabilità genetica in popolazioni occidentali di Occhione *Burhinus oedicnemus* (Charadriiformes, Burhinidae)

Author: **Alessia Mori** amori@biologia.unipi.it

Supervisors: Prof. Emilio Baldaccini, Prof. Dimitri Giunchi.

Academic Year: 2014-2015.

Abstract

1. In Europe, the mechanization and intensification of agriculture and the change in land use led to a severe decline of many steppic avian species. This situation is often worsened by the fact that many species have small isolated resident populations with limited dispersal opportunities. In order to delineate appropriate conservation plans, understanding the population structure of a species of conservation concern and quantifying the exchanges among different populations are crucial. For migratory species, the identification of year-round geographical ranges and the quantification of the degree of migratory connectivity are fundamental to define precisely the areas where the conservation efforts should be addressed.

2. My Doctoral project focused on the Stone curlew *Burhinus oedicnemus,* an European conservation concern steppic species relatively poorly investigated, with the aims to study population genetic structure and movements of Stone curlews of the western part of its distribution range and, in particular, of the Mediterranean area.

3. The level of genetic diversity and rate of exchanges were analysed by means of mitochondrial and nuclear markers among different populations representing the four subspecies inhabiting the western Palaearctic and the Canary Islands. In particular, continental and insular populations were analysed in order to evaluate the genetic structure and the congruence between morphological subspecies and samples belonging to different geographic locations. Genetic results revealed a significant differentiation of the Canary Island populations from those sampled in the Mediterranean basin. Besides, inside Mediterranean basin a relevant level of nuclear genetic diversity was found, with the distinction of several population groups, in particular insular populations.

4. The wintering areas and migration strategy of a Stone curlews population breeding in the Taro River Regional Park (Parma, Northern Italy) were studied by integrating the information obtained from ringing recoveries, geolocators, and GPS data loggers. The different sources resulted coherent, indicating that tagged Stone curlews remained in the Mediterranean basin all the year and spent the winter in Sardinia or in Tunisia. These wintering sites coincided with areas where breeding populations are reported, highlighting the importance of these areas for the conservation of the species throughout the entire year. Furthermore, this study represents the first thorough analysis performed to uncover the movements of a Mediterranean population of

Stone curlews, and it also proves the great potential of the tracking devices to provide information on the migration and non-breeding sites of elusive species, for which the application of mark–recapture/re-sighting techniques is affected by profound limitations.

5. In conclusion, these results revealed a high intraspecific genetic variability in the Western Palaearctic Stone curlews and enlightened a crucial role of Mediterranean islands, both as reservoir of genetic diversity and favourable sites both for breeding and wintering birds, emphasising the importance of these areas for the conservation of the Stone curlew throughout the annual cycle.

REFERENCES

Agostini N., Panuccio M., Lucia G., Liuzzi C., Amato P., Provenza A., Gustin M. & Mellone U., 2009. Evidence for age-dependent migration strategies in the Short-toed Eagle. British Birds 102 (9): 506-508.

Agostini N. & Panuccio M., 2010. Western Marsh harrier (*Circus aeruginosus*) migration through the Mediterranean sea: a review. Journal of Raptor Research 44 (2): 136-142.

Ambrosini R., Rubolini D., Trovò P., Liberini G., Bandini M., Romano A., Sicurella B., Scandolara C., Romano M. & Saino N, 2012. Maintenance of livestock farming may buffer population decline of the Barn Swallow *Hirundo rustica*. Bird Conservation International 22 (4): 411-428.

Ambrosini R., Borgoni R., Rubolini D., Sicurella B., Fiedler W., Bairlein F., Baillie S.R., Robinson R.A., Clark J.A., Spina F. & Saino N., 2014. Modelling the progression of bird migration with conditional autoregressive models applied to ringing data. PLoS ONE 9 (7): e102440.

Barbanera F., Forcina G., Cappello A., Guerrini M., van Grouw H. & Aebischer N.J., 2015. Introductions over introductions: the genomic adulteration of an early genetically valuable alien species in the United Kingdom. Biological Invasions 17: 409-422.

Caccamo C., Pollonara E., Baldaccini N.E. & Giunchi D., 2011. Diurnal and nocturnal ranging behaviour by stone curlews (*Burhinus oedicnemus*) nesting in river habitat. Ibis 153: 707-720.

Chiatante G., 2014. Distribuzione e selezione dell'habitat della ghiandaia marina *Coracias garrulus* L. in Puglia centrale. Alula 21 (1-2): 1-6.

Chiozzi G., De Marchi G. & Semere D., 2011. Coloniality in the Crab Plover *Dromas ardeola* does not depend on nest site limitation. Waterbirds, 34 (1): 77-81.

De Marchi G., Chiozzi G., Dell'Omo G. & Fasola M., 2015. Low incubation investment in the burrow-nesting Crab Plover *Dromas ardeola* permits extended foraging on a tidal food resource. Ibis 157 (1):31-43.

De Marchi G., Chiozzi G., Semere D., Mebrathu Y., Hosseini Tayefeh F. & Almalki M., 2015. Food abundance explains the breeding season of a tropical shorebird, the Crab Plover *Dromas ardeola*. Ostrich (in press) doi: 10.2989/00306525.2015.1030465

De Marchi G., Fasola M., Chiozzi G., Bellati A. & Galeotti P., 2012. Sex discrimination of Crab Plovers (*Dromas ardeola*) by morphometric traits. Waterbirds, 35 (2): 332-337.

Forcina G., Panayides P., Guerrini M., Nardi F., Gupta B.K., Mori E., Al sheikhly O.F., Mansoori J., Khaliq I., Rank D.N., Parasharya B.M., Khan A.A., Hadjigerou P. & Barbanera F., 2012. Molecular evolution of the Asian francolins (*Francolinus*, Galliformes): a modern reappraisal of a classic study in speciation. Molecular Phylogenetics and Evolution 65: 523-534.

Forcina G., Panayides P., Kassinis N., Guerrini M. & Barbanera F., 2014. Genetic characterization of game bird island populations: The conservation of the black francolin (*Francolinus francolinus*) of Cyprus. Journal for Nature Conservation 22:15-22.

Forcina G., Guerrini M., van Grouw H., Gupta B.K., Panayides P., Hadjigerou P., Al-Sheikhly O.F., Awan M.N., Khan A.A., Zeder M.A. & Barbanera F., 2015. Impacts of biological globalization in the Mediterranean: unveiling the deep history of human-mediated gamebird dispersal. Proceedings of the National Academy of Sciences of the United States of America 112: 3296-3301.

Giunchi D., Caccamo C. & Pollonara E., 2008. Pattern of wing moult and its relationship to breeding in the Eurasian Stone-curlew *Burhinus oedicnemus*. Ardea 96: 251-260.

Giunchi D., Caccamo C., Mori A., Fox J.W., Rodriguez-Godoy F., Baldaccini N.E. & Pollonara E., 2015. Pattern of non-breeding movements by Stone-curlews *Burhinus oedicnemus* breeding in Northern Italy. Journal of Ornithology (in press) doi: 10.1007/s10336-015-1219-0.

Isotti R., Luiselli L. & Fanfani A., 2014. Null model analysis of community structure reveals that patch quality influences the conservation of complex bird communities in Mediterranean habitats. Revue d'Écologie 69: 120-130.

Isotti R., Luiselli L. & Fanfani A., 2014. Null models reveal the influence of fragmentation on complex bird communities in Mediterranean habitats. Rendiconti Accademia dei Lincei (on-line) doi:10.1007/s12210-015-0405-6.

Isotti R., Luiselli L., Tinelli A. & Fanfani A., 2013. Analisi della comunità ornitica, risposte statistiche e standardizzazione del metodo. In: AA.VV., Il sistema ambientale della Tenuta Presidenziale di Castelporziano. Accad. Naz. Scienze 46, Roma.

Lucia G., Agostini N., Panuccio M., Mellone U., Chiatante G., Tarini D. & Evangelidis A., 2011. Raptor migration at Antikythira, in southern Greece. British Birds 104: 266-270.

Mori A., Dawson D.A., Horsburgh G.J., Giunchi D., Baldaccini N.E. & Baratti M., 2014. Characterisation of microsatellite markers in the stone curlew *Burhinus oedicnemus*. Conservation Genetics Resources 6: 751–754.

Mori A., Baldaccini N.E., Baratti M., Caccamo C., Dessì Fulgheri F., Grasso R., Nouira S., Ouni R., Pollonara E., Rodriguez-Godoy F., Spena M.T. & Giunchi D., 2014. A first assessment of genetic variability in the Eurasian Stone-curlew *Burhinus oedicnemus*. Ibis 156: 687–692

Panuccio M., 2011. Across and around a barrier: migration ecology of raptors in the Mediterranean basin. Scientifica Acta 5 (1) : 27-36.

Panuccio M., 2011. Wind effects on visible raptor migration in Spring at the Strait of Messina, Southern Italy. Journal of Raptor Research 45 (1): 88-92.

Panuccio M., Agostini N., Baghino L. & Bogliani G., 2013.Visible Migration of Short-Toed Snake-Eagles: Interplay of Weather and Topographical Features. Journal of Raptor Research 47 (1): 60-68.

Panuccio M., Agostini N., Lucia G., Mellone U., Ashton-Boot J., Wilson S., Chiatante G. & Todisco S., 2010. Local weather conditions affect migration strategies of adult Western Honey Buzzards (*Pernis apivorus*) through an isthmus area. Zoological Studies 49 (5): 651-656.

Panuccio M., Agostini N., Mellone U. & Bogliani G., 2014. Circannual variation in movement patterns of the Black Kite (*Milvus migrans migrans*): a review. Ethology, Ecology & Evolution 26 (1): 1-18.

Panuccio M., Agostini N. & Premuda G., 2012. Ecological barriers promote risk minimization and social learning in migrating Short-toed Snake Eagles. Ethology Ecology & Evolution 24 (1): 74-80.

Panuccio M., Chiatante G. & Tarini D., 2013. Two different migration strategies in response to an ecological barrier: Western Marsh Harriers and juvenile European Honey Buzzards crossing the central-eastern Mediterranean in autumn. Journal of Biological Research-Thessaloniki 19: 10-18.

Panuccio M., Gustin M. & Bogliani G., 2011. A comparison of two methods for monitoring migrating broad-winged Raptors approaching a long water crossing. Avocetta 35: 13-17.

Panuccio M., Lucia G., Agostini N., Ottonello D. & Bogliani G., 2015. Motion capacity, geography and ecological features explain the present distribution of a migratory top predator. Ecological Research 30: 181-190.

Panuccio M., Mellone U. & Muner L., 2013. Differential wintering area selection in Eurasian Marsh Harrier (*Circus aeruginosus*): a ringing recoveries analysis. Bird Study 60: 52-59.

Pirrello S., Pilastro A. & Serra L., 2015. Nest-dwelling ectoparasites influence the start and duration of the first pre-basic moult in the European starling *Sturnus vulgaris*. Journal of Avian Biology (in press) doi: 10.1111/jav.00565.

Scandolara C., Rubolini D., Ambrosini R., Caprioli M., Hahn S., Liechti F., Romano A., Romano M., Sicurella B. & Saino N., 2014. Impact of miniaturized geolocators on barn swallow *Hirundo rustica* fitness traits. Journal of Avian Biology 45 (5): 417-423.

Serra L., Pirrello S., Caprioli M., Griggio M., Andreotti A., Romano A., Pilastro A., Saino N., Sacchi R., Galeotti P., Fasola M., Spina F. & Rubolini D., 2012. Seasonal decline of offspring quality in the European Starling *Sturnus vulgaris*: an immune challenge experiment. Behavioral Ecology and Sociobiology 66 (5): 697-709.

Sicurella B., Caffi M., Caprioli M., Rubolini D., Saino N. & Ambrosini R., 2015. Weather conditions, brood size and hatching order affect Common Swift *Apus apus* nestlings' survival and growth. Bird Study 62 (1): 64-77.

Sicurella B., Caprioli M., Romano A., Romano M., Rubolini D., Saino N. & Ambrosini R., 2014. Hayfield enhance colony size of the Barn Swallow *Hirundo rustica* in northern Italy. Bird Conservation International 24 (1): 17-31.

Tayefeh F.H., Zakaria M., De Marchi G., Amini H., Moradi A., Ahmadpour P. & Ghasemi S., 2013. Breeding Biology of the Crab Plover (Dromas ardeola) on the Mond Islands, Northern Persian Gulf, Iran. Waterbirds 36 (4): 448-462.