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Évora - Portugal

Book of Abstracts

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BOOK OF ABSTRACTS

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KEYNOTE PRESENTATIONS

52 years among Ural and Tawny Owls *Strix uralensis* and *S. aluco* - Why?

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Keywords: Ural Owl; long-term study; population parameters; demographics; Finland

The Ural Owl *Strix uralensis* breeds in the northern forests of the Palaearctic and in isolated mountain forests of central and southern Europe. Despite its wide distribution, very little was known in the early 1960s about the ecology of the Ural Owl. In Finland the species was suffering from the lack of ideal natural nest-sites - large cavities and chimney-like stumps of big trees - which had been "cleaned off" from commercial forests. Thus, Ural Owls had to try to breed in disused twig-nests constructed by diurnal raptors – often with poor success.

In the 1960s, conservation-oriented Finnish bird ringers started to provide nest-boxes for hole-nesting owls to compensate the losses caused by commercial forestry, which opened an excellent opportunity to gather field data on owls breeding in nest-boxes. Now, 50 years later, the Ural Owl, together with the Boreal Owl *Aegolius funereus*, are among the best-studied bird species in Finland.

Thus, the first reason, why I became interested in the Ural Owl, was conservation. In 1965, I started my long-term conservation and research project on the Ural Owl in Häme, southern Finland (61.0 N / 24.5 E). During 1965–2016, the annual number of breeding pairs in my total study population, which also includes data from two amateur ringers, has varied from 9 to 204 pairs, depending on the phase of the vole cycle. In bad vole years, most of the pairs stay in their territories, but are not able to produce any eggs.

The second reason to work with the Ural Owl was to try to gather new data on this poorly known species, which is in many aspects an ideal species for population studies. The breeding female can be easily and safely trapped any time during the breeding season, even before the egg-laying, because the Ural Owl "never" deserts the eggs or young as a result of gentle disturbance caused by a trained researcher. Trapping the males is more difficult, but is successful with experience

and stamina. Because both sexes are very site tenacious, it is possible to gather relevant and reliable long-term data for estimating survival, lifetime reproduction, etc.

The Ural Owl is a generalist feeder and feeds on a wide variety of vertebrates, ranging from frogs and shrews to mammals and birds weighing up to several hundred grams. However, in Finland, the population dynamics of the Ural Owl is highly dependent on 3–4-year cycles of microtines: the Field Vole *Microtus agrestis*, Bank Vole *Clethrionymus glareolus* and Water Vole *Arvicola terrestris.* My main goal has been to try to find out how different population parameters like age at first breeding, onset of egg-laying, clutch size, brood size, survival of different age-classes, recruitment, and natal and breeding dispersal vary in relation to fluctuating environment. For comparisons, I have collected similar data on the close relative, the Tawny Owl *Strix aluco*, a newcomer from the south.

The third reason to spend much of my lifetime with Ural Owls has been and still is the privilege to have an opportunity to be legally in close contact with different individuals of such a fascinating species, which defends its offspring with a kamikaze-like fearlessness and fierceness. During the decades, some individuals have become my “friends” and even been given anthropomorphic names like *Mama of Yltiö*, *Papa of Hyypiö,* etc. For the general public, the most interesting part of my study has been information about “divorces” and polygamy based on the real lives of Ural Owls. My presentation will be a mixture of memories through the decades and selected facts about the life of the Ural Owl.

Owls in Myth and Culture – Insights from 30 Countries

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Keywords: ethnobiology; owls; culture; myth; beliefs; interview

Owls are easily recognizable, and in cultural contexts have prominent positions on par with bears, sharks, tigers, rhinos and elephants. Cave paintings, archeological and anthropological evidence indicate the human-owl relationship goes very deep in time. This relationship is also very widespread, as there are myths and legends about owls in every culture. It follows that beliefs and attitudes about owls should have a fundamental role in the protection and conservation (or lack thereof) for owls. In 2009, the Global Owl Project (GLOW) began a project to scientifically examine this topic. What do people *really* believe about owls? How do these beliefs influence owl populations and current owl conservation efforts? GLOW teams developed a 4-page interview form with questions to obtain information about the interviewee, their ecological knowledge about owls, and their understanding of owl myths and legends. This form has been translated into 18 languages, and about 6,000 interviews have been conducted in 28 countries. In addition to the interviews, we also did an extensive literature search, and reviewed archeological, anthropological, art, and religious aspects of the human-owl relationship. Results were rich, illuminating, sometimes startling, and varied tremendously across societies. Owls are viewed across the spectrum as being very dangerous spirits who are associated with death, to a sacred Creator Being (who started the earth), to realistic (predatory species within ecosystems). Interestingly, we found that beliefs about owls have not changed whatsoever in some countries since the late 1800's, while beliefs in other societies are changing rapidly. Some cultures now view owls as "just birds." Importantly, as part of this effort, we also discovered significant illegal trade in live and dead owls, and owl eggs, with associated negative impacts on owl populations. In terms of owl protection and conservation, an intermingling of beliefs and environmental law both have roles to play. In some countries and cultures, educational activities about owls urgently need to incorporate an understanding of the background cultural beliefs

about owls in their respective regions. Work from this project is being submitted to the Society of Ethnobiology as a monograph in its "Contributions in Ethnobiology" series. An international Smithsonian Institution travelling exhibition on "Spirit Wings - Owls in Myth and Culture" is planned.

Being with owls – From faunistic surveys to ecosystem research

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Keywords: owl monitoring; *Strix uralensis; Strix aluco; Aegolius funereus*; southern Europe

Recent survey of raptor monitoring programs in Europe revealed that the monitoring of owls (11.8±8.8 monitoring schemes per species) is significantly scarcer compared to diurnal raptors (23.6±14.6). The most monitored owl species being Tawny, Long-eared and Eagle Owl, but there are big monitoring gaps in Barn, Pygmy, Boreal and Scops Owl with 25% or less of their European population being monitored. A case of multispecies monitoring scheme from central Slovenia (southern Europe) is presented covering already 20 years (1998-2017) of monitoring of Ural (TRIM estimated trend: +6.3±1.1%, $p<0.01$), Tawny (+3.8±1.2%, $p<0.01$) and Boreal Owls (-2.0±2.0%, NS). Monitoring is performed with playback broadcast, and supplemented with nest-boxes. In territorial response to playback, owls usually do not respond only to conspecific but also to heterospecific calls of sympatric owls. The level of interspecific territoriality is reflected also at the spatial level indicating strong competitive interactions. Forests in southern Europe are dominated by mice (Apodemus), voles (Myodes) and dormice (Glis) with relatively complex owl prey availability conditions which are intra- and interseasonally variable. Both Strix species responded to this differently; Tawny Owl with greater diet shift and reduced clutches, Ural Owl with nesting abstinence or late breeding. The Ural Owl shifts its diet greatly throughout the year with mice and voles predominating in winter and spring, and dormice in summer and autumn. In Europe, the Ural Owl is distributed from boreal to temperate regions. Although diet differs among regions due to local prey availability, voles are the main prey, even in southern mice-dominated environments. Owl breeding populations correlate with small mammal abundance, but these fluctuation correlations have even broader ecosystem reflections, i.e., ground beetles (Carabidae) fluctuate in the same way. Ural Owl territories also hold a significantly higher biodiversity of ground beetles than Tawny Owl territories. The relationship of owls as top

predators with other non-prey species is still an understudied phenomena, but as indicated could hide inevitable role of owls in the ecosystems.

Living in a variable environment: Tengmalm's and Pygmy Owls and the three-year high-amplitude population cycle of voles

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Keywords: food limitation; population dynamics; reproductive success; loss of boreal forest; climate change

Lack (1954) postulated that to prove that numbers of birds are limited by food supply, one must not only measure the abundance and availability of main foods and the quantity of each consumed, but to study interactions between the numbers of the bird and those of its prey over a period of years. This was the point of departure for my long-term studies on vole-eating birds of prey including Tengmalm's (boreal) and Pygmy Owls in western Finland. The high-amplitude northern three-year population cycle of voles creates fat and lean periods for owls. In the talk, food limitation on food storing behaviour, breeding density, parental body condition, laying date, clutch size, reproductive success and hatching asynchrony of owls in relation to vole abundances are reviewed. The conclusion is that high-amplitude temporal variation in vole abundance is the main determinant of population dynamics and life-history traits of Tengmalm's and Pygmy Owls. Food abundance appears to limit reproductive success of owls even in years of "superabundant food" (sensu Lack). In addition, there is a pressing need to understand how global changes in climate interact with intensification of forestry practices in boreal ecosystems. Therefore, we investigated the relative influence of autumn climate and forest loss on the food-storing behaviour of Pygmy Owls 12 years. Increasing frequency of days with precipitation during the autumn triggered a decrease in the total prey biomass stored, the number of Bank Voles (main prey) found in larders, and in the body condition of females. Pygmy Owls settled in high-quality territories (harbouring high proportion of old spruce forests and low proportion of clear-cut areas) exhibited a stronger functional response to variations in main prey abundance and were more prone to switch from main prey to alternative prey (passerine birds) depending on local climate conditions. This suggests that high-quality forest habitat may allow Pygmy Owls to buffer negative effects of inclement weather and cyclic variation in main prey abundance. Our results

suggest that rainier autumns could reduce the vulnerability of voles to predation by Pygmy Owls, because long-term temporal stability in local vole abundance refutes the alternative hypothesis of climate-driven changes in vole abundance. As small rodents are key prey species for many predators in northern ecosystems, these findings raise concern about the impact of global change on boreal food webs through changes in main prey vulnerability.

ORAL PRESENTATIONS

Breeding biology and behaviour

The breeding density of the Eurasian Scops Owl *Otus scops* along the eastern Adriatic coast: Slovenia, Croatia and Montenegro

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Keywords: survey, mediterranian region, urban areas, singing males, playback method

The Eurasian Scops Owl *Otus scops* is widespread owl breeder across much of southern and eastern Europe, but still one of least studied owl species in Europe. Its abundance in many European countries is declining. From the area of eastern Adriatic coast there are only few studies on the species available from Croatia and Slovenia. We aimed to determine breeding density (abundance, spatial distribution and density) of the species along the eastern Adriatic coast. Singing males were surveyed at six study areas distributed along the coast from Slovenia, Croatia to Montenegro in the breeding seasons from 2012 until 2017. The playback method was used applied at 546 count points. Within each survey area count points were spaced 500 to 1500 m, depending on the openness and forest cover. The breeding densities ranged from 0.19 to 1.63 males/km2, with the highest denisties recorded in Pula (1.63 males/km2), Novi Vinodolski (0.90 males/km2) and Slovenian Istria (0.71 males/km2). The spatial distribution of the Eurasian Scops Owl along the the eastern Adriatic coast is not uniform, but locally clustered, mostly to settlements. In settlements the bulk of the population was found. The most likely reason for large densities of Scops Owls in settlements is asumed to be related to owl nesting in houses and feeding with insects that are attracted by the street lamps, but perhaps also the cosequences of predator release effect, which has been shown to be an important in habitat selection of small owl species.

The Reproductive Success of Lanyu Scops Owls *Otus elegans botelensis*

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Keywords: *Otus elegans botelensis*, breeding, life-long reproduction

Lanyu Scops Owl *Otus elegans botelensis* is found on a small oceanic island east of Taiwan. There were 55 male and 49 female known aged birds in my study area between 1998 and 2007. Only 39 males and 35 females bred. Besides two females with brood patches but whose nests were never found, 11 of the males and three of the females produced no offspring. Males at first breeding were mostly 2 to 4 years old, the oldest being 7. The number of years a male bred ranged from 1 to 6, with 2 being the mode. Females at first breeding were also mostly 2 to 4 years old, but the oldest was 10. The number of years a female bred ranged from 1 to 10, with 3 being the mode. Clutch size for this species was mostly two or three eggs. Total reproduction in 9 years was 90 offspring for males, ranging from 0 to 10 per individual, with one or two young being the mode. Total reproduction was 134 for females, ranging from 0 to 15 per female, with two young being the mode. Long living breeders had several mates in their life time. Some males produced young until they were 12 years old and females until they were 13 years old. The most successful male bred 5 times and produced 10 young. The most successful female bred 6 times and produced 15 young, while another female bred 10 times and produced 14 young. Only a small proportion of their offspring bred in my study area, and very few of these succeeded at producing young. The high life long reproductive success of an owl does not guarantee the breeding success of its offspring in this species.

Breeding ecology of captive-released and wild Western Burrowing Owls *Athene cunicularia hypugaea* in southwestern Manitoba, Canada

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Keywords: Burrowing Owl; *Athene cunicularia*; Endangered Species Recovery Program; reintroduction; breeding ecology

Western Burrowing Owl *Athene cunicularia hypugaea* populations have shown steady and steep declines across western Canada in the last 50 years. Many inter-related factors are thought to be responsible for its rapid decline. A breeding ecology study was initiated in Manitoba to identify existing and emerging threats for wild pairs and to assess a modified reintroduction technique using food supplements to promote nesting success, recruitment, and survival of captive-released first-year Burrowing Owl pairs to augment wild populations. Breeding, foraging and behavioural data of captive-released and wild Burrowing Owls were recorded and compared from 2010-2012. During this period 14 pairs of captive-released owls and six pairs of wild owls were monitored. Average clutch size for six wild first clutches (8.8 eggs) was higher than for 10 captive-released first clutches (6.5 eggs). Likewise, average replacement clutch size for four wild pairs (6.8) was higher than that of two captive-released pairs (5.0). Overall, hatching success for wild owls was 69% and captive-released owls was 60%. Fledging success was 100% for captive-released and monitored wild nests which fledged 27 and 20 young, respectively. Broods were reduced prior to fledging to increase body condition and survival of remaining young prior to migration. This study demonstrated that this captive-release recovery method was at least initially successful. It remains to be seen if young produced survive over the longer term and contribute to the recovery of this endangered species in Canada.

Breeding of the Desert Owl *Strix hadorami* in Egypt, and notes on its behavior

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Keywords: Desert owl, *Strix hadorami*, Egypt, call playback ,wadis

We present results of a survey for breeding Desert Owls *Strix hadorami* in all formerly known locations in Egypt as well as in other seemingly suitable wadis in the Red Sea and south Sinai governorates, especially in sites not surveyed during previous studies. Call playback is the most efficient method for locating owls at numerous sites and doubles the chance of detecting an owl at night, compared with passive listening. The survey routes at each wadi consisted of 10 stops spaced one km apart for a total route length of 10 km. In the eastern desert, Red Sea, Egypt, the owl occupies rocky and stony desert wadis habitat specially, even where it has not rained in over five years. The Desert Owl visits fresh water springs frequently for drinking and bathing. The owl pellets are compressed, and consist mainly of voles with some invertebrate and bird materials. The owl has a very pale 'badge' of feathers on the throat and a few erected back feathers with whitish bars that are visible during vocal displays. The Pharaoh Eagle Owl *Bubo ascalaphus* likely limits the distribution of the Desert Owl, as it occupies cliffs close to human settlements in the Nile Valley and tourist resorts along the Red Sea shore, thereby preventing the Desert Owl to expand its range from deep wadis and rocky slopes. Of the five wadis we visited in the eastern desert we found breeding at only one wadi where it had rained during the last three months. The availability of food in that location indicated that the availability of food is a limiting factor for breeding.

How do Barn Owl nestlings share food? An automatic interactive playback experiment

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Keywords: *Tyto alba*; sibling negotiation; communication; food competition

To resolve a contest over resources, animals can exchange information about their competitive ability and their motivation to compete. How do siblings resolve the conflict over who will get an indivisible food item brought by a parent? Do they compete physically or do they find a way to resolve the conflict pacifically? We already showed that in the absence of parents, Barn Owl nestlings *Tyto alba* vocally negotiate which of them will have priority access to the incoming food item. The hungriest individual vocalises intensely to indicate to its siblings its motivation to compete once parents are back with a food item. As a response, its siblings retreat from the contest. Thus, vocal "sibling negotiation" reduces the overall level of sibling competition. To understand the rules used to vocally negotiate priority access to food resources, we developed an interactive playback experiment that broadcast prerecorded calls depending on how the owl behaves. Our experiment revealed that to deter siblings from vocalising and thus, getting priority access to the next food item, nestlings should increase call rate but only when siblings decrease their call rate. Reversely, nestlings should increase the duration of their calls when siblings increase the duration of their own calls. Barn Owl nestlings thus adjust their negotiation according to their sibling negotiation within short time periods. We argue that such adjustments could allow individuals to increase communication efficiency, keeping competition costs the lowest.

Detailed analysis of Eagle Owl behaviour during courtship and egg incubation based on continuous IR-video recording at the nest site

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Keywords: *Bubo bubo*, video surveillance, behaviour, courtship, incubation

A complete reproductive cycle - from pre-courting until the departure of the fledglings - has been captured by IR-video camera in order to fully document and assess the undisturbed behaviour of Eurasian Eagle Owls *Bubo bubo* at their nest site. The camera was installed in December 2014 at a site previously used for several successful broods, and was operated until early June for 177 days comprising more than 2630 hours of recorded video data. The nest site was located in a rocky cliff (former quarry) in the Upper Rhine Valley near Freiburg (southwestern Germany) within a landscape featuring agricultural fields, vineyards and patches of mixed-wood forest, an active limestone quarry, gravel mining and several small villages. Almost 100% of the night and 50-90% of daytime hours were recorded. Videos were evaluated visually; detailed accounts of all activities and behaviours were extracted and transcribed into a spreadsheet format for evaluation by qualitative, quantitative and time-related criteria. Of special interest were the number and duration of behaviours and activities, and also their distribution in time, daily and within a defined developmental period. To date, about half of the files have been evaluated covering 52 days of pre-laying courtship activities and 41 days of brooding until the three chicks hatched. Some of the many surprise findings will be presented. Unexpectedly, during courtship, prey delivery played a minor role in attracting the female to the nest site compared to visual and auditory displays of the male. Unexpectedly, during egg incubation, prey delivery at times fell short of the female's requirements. Unexpectedly, the male tried to copulate over 30 times in the midst of the incubation period but was rejected forcefully. Video clips showing examples of the typical and the unusual Eagle Owl behaviours at the nest site are available for viewing on Youtube, channel "cth-ornitho".

Vocal development of the Great Horned Owl

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Keywords: vocalizations; Great Horned Owl; *Bubo virginianus*; hoots; vocal development

Our goal was to document the vocal development of the Great Horned Owl *Bubo virginianus*. We allowed two wild, non-releasable adult Great Horned Owls to breed in a two-chambered aviary complex 29m long x 3m wide x 4m high with very little human contact. Three broods were reared, totalling 4 female and 3 male offspring, with at least one of each sex in each brood. Two broods were parent-reared and one brood was human-reared from 2 weeks of age. Through the use of seven security cameras and microphones, we discretely observed and recorded the owls. Two pan-tilt-zoom cameras streamed live to the internet. Online camera viewers were asked to submit observation forms when they observed significant vocalizations. Two camera observers with remote access to all seven cameras submitted daily notes, normally from dusk to dawn, detailing all vocalizations and behaviors. Owlets began vocalizating in the egg 2 days before hatching. Owlets began hooting in quiet, high-pitched voices at 12-18 days of age and continued until they were 23-32 days. They began hooting again with cracking voices at 19-23 weeks. Their hoots became indistinguishable from adults at 29-32 weeks. Human-reared owlets developed normal vocalizations within the same timeframe as parent-reared owlets, although they could not be acoustically isolated from adults of their species in our facilities. To our knowledge this is the first documentation of the vocal development of any owl species in the world.

Male Little Owl *Athene noctua* taking over broodcare

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Keywords: little owl; male brooding and feeding; stone marten

In 2017 we observed a Little Owl *Athene noctua* nest using three online video cameras to document breeding behavior. On 22 May a stone marten visited the nest. The female left her three 5-day old owlets in the nest to immediately join her mate in attacking the marten. The marten never entered the nest box and left after 7 minutes. The owlets were unharmed, but the female owl was never seen again. The male took over feeding the owlets, which were too young to accept whole prey. He also began brooding the owlets. The male was clumsy at first, but eventually tore up the food for the owlets and successfully fed them. As he still had to leave the nest to hunt, he could not brood all day long and on 24 May all three owlets died. The male ate parts of the owlets and removed their remains from the nest box. That evening he called loudly near the nest. On 26 May a new female arrived. Although they copulated, no replacement clutch was laid. As far as we are aware, this is the first documented case of a male Little Owl brooding young owlets and tearing up food to feed them.

Breeding biology of the Mottled Wood Owl *Strix ocellata* in West-Central India

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Keywords: nest sites; reproduction; Mottled Wood Owl; India

The Mottled Wood Owl *Strix ocellata*, an endemic to the Indian subcontinent, is one of the least studied owls in the world. Centered around Pune, west-central India, we collected data on owl nest sites during 9 years between 2005-2016 (i.e., except for 2009, 2014 and 2015). Pellets were collected at the nest sites to elucidate the prey base of the species. Using Google Earth, we quantified the general habitat mosaic for a 5-km radius around the nest site and ground-proofed these during our visits. In 20 breeding attempts from 5 different pairs (1 each from 2 pairs; 3, 7 and 8 attempts each from three other pairs) we followed the whole cycle from egg-laying to fledging of the young. In these, a total of 44 eggs were laid, of which 38 (86.4%) hatched, and 30 (68.2%) fledged. The overall fledging success was 1.5 young/breeding pair. The average clutch size was 2.55 eggs (±0.51, N = 20; 2 eggs - 9 clutches, 3 eggs - 11 clutches)/breeding attempt, of which an average 2.2 young (± 0.41, 1-3) successfully hatched. Fledging success was 1.81 (± 0.93) young/nest. Nests were placed in natural hollows; all were open to the sky, in Mango *Mangifera indica* (52%), Tamarind *Tamarindus indica* (22%), Peepal *Ficus religiosa* (15%), and Rain *Samanea saman* (7%) trees. Nests were widely scattered and the distances between territories averaged 26.7 km (± 5.8; 15.3 - 34.2 km, N = subset of 5 nests). From 1,033 pellets analyzed, 711 prey were identified, reflecting insects (39%), small mammals (rodents 10%; shrews 21%, bats 3%), birds (11%), reptiles (9%), scorpion (1%), amphibians (1%), and molluscs (4%). Although designated as a species of Least Concern owing to its wide distribution and breeding range, the lack of any knowledge of the true levels of breeding populations, its ecological requirements, and human related development and persecution, could easily result in the species becoming vulnerable.

Literature

Little Owl *Athene noctua* Literature Update (2007-2017) and Long-term Research Trends

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Keywords: Little Owl; *Athene noctua*; literature; research topics

Our understanding of owl biology is poor compared with that of most birds. The Little Owl *Athene noctua* has become one of the best models for biological and conservation research due to its commonness and because it readily occupies nest-boxes. This presentation adds 233 Little Owl publications to those found in the monograph 'The Little Owl: Conservation, Ecology and Behavior of *Athene Noctua*' (2008). This monograph contains 1,901 references from 1769 to 2006. We classified 2,134 references by keywords and geographical origin and report on a shift in these variables through time. Over half the references (n=1,266; 59%) originate from Germany (n=396; 1980-2000), France (n=390; 1960-2000), the United Kingdom (n=249; 1900-1970), Italy (n=128; 1980-2000) and the Netherlands (n=103; 1980-2000). Emerging source countries since 2000 are Switzerland (n=96), Spain (n=88) and Czech Republic (n=43). The change in research interests through time was analyzing using keywords (n=4,672) by decade. The keywords 'distribution', 'diet', 'behavior', 'biology' and 'mortality' generally followed the change in the total number of publications between the 1900s and 2010s. Other keywords were only found during specific periods. Vocalizations ('song') were mostly studied in the 1980s and 2000s. Conservation initiatives ('nest-box', 'conservation') peaked in the 1980s and then systematically declined until the 2010s. 'Habitat selection' followed the general trend but ceased during the current decade. Recent topics includes 'food supplementation', 'natal dispersal', 'telemetry, 'multiple scales', 'dispersion', 'energetic constraints', 'phylogeography', 'intraguild predator', 'wildlife rehabilitation centre', 'integrated population models' and 'habitat quality'. These recent topics correspond to those identified in a research priorities chapter of the aforementioned 2008

monograph. An overview of new Little Owl research literature trends and how insights into this species are advancing will be presented.

Conservation

Global owl distribution, diversity, and conservation hotspots

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Keywords: owls, distribution maps, geodatabase, hotspot analysis, conservation

Global diversity assessments contribute to understanding large taxonomic groups, and conservation efforts depend on knowledge of taxonomic status, distribution and abundance of species. These assessments and associated databases provide a basis for studying patterns and changes in species distribution and diversity, especially in light of global issues such as climate change. Owls are excellent indicators of biodiversity and ecosystem health, and can be used to identify conservation targets. We developed a geodatabase of 221 species range maps and analyzed the characteristics of the global distribution of owls. Goals of this study were to assess global owl distribution and identify owl conservation priorities, and to inform researchers of the resulting open access geodatabase. Species maps were obtained from Bird Life International, by digitizing Konig and Weick's *Owls of the World* maps (2008), and from species-specific data. Using GIS, species-specific grid maps were created and combined to visualize distribution of owl species richness. Standard deviation was used to highlight areas with highest relative value, and therefore highest concern in terms of conservation need. The largest grouping of owl species in the same geographic area was 20, though 5-10 was more common. Threatened species (32) were concentrated along the west African coast and on islands, especially in the South Pacific. About one third of all owl species (75) fall into the restricted-range category, mostly in the Western Hemisphere and Africa. We identified 3 major hotspots: South America, Africa, and Indonesia, which had high numbers of threatened and/or restricted range species. Our diversity hotspot maps identify 3 major conservation target areas from a weighted analysis of threatened

and endemic species which represent ideal locations for concentrating conservation efforts. Correlation between owl species hotspots and other comparable studies provides strong evidence that owls can serve as a biodiversity indicator standard.

Knocking on the door of extinction: population dynamics and conservation measures for Little Owl in the Czech Republic

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Keywords: *Athene noctua*; population dynamics; mortality; breeding places; conservation measures

The Little Owl *Athene noctua* population has declined significantly in many areas of central Europe, with some regional populations now extinct or on the brink of extinction. In this contribution I would like to present current research population dynamics and conservation measures for the Little Owl in the Czech Republic. Although the species was widely distributed across the whole territory of Czech Republic and belonged to the most numerous farmland owl species at the beginning of the last century, since the 1970´s and 1980´s the population has declined markedly. Just during last two decades, the breeding population declined about 87–94 % and the current population is estimated at 130 breeding pairs. The analysis of expected breeding places of the Little Owl confirmed a strong preference for man-made objects over the original breeding sites in tree cavities. Large-scale land use change is assumed to be the main reason behind the decline, however the small and isolated populations are heavily endangered by other factors, such as mortality in anthropogenic traps (e.g. drowning in water reservoirs/basins, death in chimneys and hay blowers) which represent the main cause of Little Owl mortality. The current conservation measures to increase the Little Owl population are mainly focused on supporting high-quality foraging habitats (e.g. spatio-temporal grassland management in the little owl territories), nesting opportunities (e.g. installation of predator-safe nest boxes) or reducing of anthropogenic mortality (e.g. elimination of anthropogenic traps) in recently occupied localities to facilitate dispersal and gene flow between individual subpopulations.

Reintroducing the Ural Owl *Strix uralensis* to Austria - Ingredients for a successful comeback

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Keywords: reintroduction, *Strix uralensis,* austrian alps, monitoring

The Ural Owl *Strix uralensis* became locally extinct in Austria (Europe) around 60 years ago. Since 2008 a reintroduction project for the Ural Owl has taken place to reestablish the species in the Austrian woods. A renewed distribution in the Alps will establish an essential connection between the remaining populations south (Slovenia, Italy) and north (Germany, Czech Republic) of Austria and the alpine arch. Individuals that occasionally migrate between the newly established population in Austria and the ones in the neighbouring countries ensure a genetic flow within European metapopulations, which is vital for the survival of the big owl in the long term. Since the start of the project and until end of 2016, 267 owls have been released. Between 2011 and 2017 and a minimum of 60 broods (including unsuccessful breeding attempts) in the wild could be verified with a total number of 117 owlets fledged. The average number of owlets fledged in the field was 2.6 per successful brood.

We present an overview of the most important factors for a successful reintroduction project in the three main areas of breeding, release and monitoring. Requirements for successful breeding of Ural Owls for release as well as administration and development of the breeding network are discussed. The method of release is explained and lessons learned from 9 years of experience are demonstrated. For the monitoring section, we show that the combination and interconnection of monitoring methods used, helps to re-identify birds on a regular basis and keep an eye on the development of the population in the field. Monitoring methods adressed and evaluated include the installation of nestboxes, special colour rings with inserted RFID Chips for re-identification, telemetry and establishment of a genetic monitoring system.

Review of, and advances in, the captive propagation and conservation of the Western Burrowing Owl *Athene cunicularia* in British Columbia, 1983-2016

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Keywords: Burrowing Owl; reintroduction; captive breeding; migration; soft release; British Columbia

The Burrowing Owl *Athene cunicularia* is an Endangered species in Canada and was extirpated from British Columbia (BC) in the 1980s. In Canada, populations of Burrowing Owls migrate in the fall to the southern United States and Mexico. With a loss or degradation of native habitat, both in nesting and overwintering grounds, along with the decline in fossorial mammals, and possible effects of climate change, Burrowing Owl populations continue to decrease in BC and Canada. In 1990, volunteers initiated a comprehensive re-introduction program, including three captive breeding facilities, artificial burrow networks and field monitoring research. The Burrowing Owl Conservation Society of BC produces over 100 owls each yr to release in the Nicola Valley and South Okanagan grasslands of BC. Artificial burrows are prepared on private ranch land, provincial land and Non-government Organization properties. Improved release techniques, including soft-release cages in 2005, have resulted in higher adult survival and greater numbers of wild-hatched offspring with the potential to return in following years. Owls returning to BC after migration currently number between 10-23 birds per yr. We have confirmed sightings of owls across their migration route in Washington, Oregon and California. The Burrowing Owl program in BC is a prime example of an applied conservation project with strong community support and also represents great opportunities for research on Burrowing Owls in their northern range.

Field observations of Pere David's Owl *Strix davidi* in Central China, 140 years after its first description

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Keywords: *Strix davidi*, plumage of adults and juveniles, vocalization, taxonomic comparisons

Due to the detection of Pere David's Owls in Lian Hua Shan-reserve, in the Province of Gansu, we took the chance to collect any data on appearance, plumage, vocalization, behaviour and breeding activity of at least two territorial pairs. Our aim was to actualise our knowledge of this rare species, as observations are largely lacking since the first collection of a specimen by Pere David in 1869. During several stays in the reserve we managed systematic documentation by photographs and nest-box-videos, tape recordings, measurements of fledglings, and protocols of courtship, copulations, prey-delivery and feeding of fledglings, as well as nest defence and attacks against enemies. From 1995 to 2016 we could confirm > 13 broods, with a minimum of 23 nestlings. Our results allow a basic revision of the general description of Pere David's Owl, as misleading characters are labelled in literature, caused on the one hand by wrong interpretations of the original description by Sharpe in 1875, and by fundamental confusion of several owl species, named synonymic in the 19th century on the other hand. Based on our material we are able to present photographic documents of male and females plumages, of eggs, nestlings, and fledglings for the very first time. A first step is done, to design the structure of the vocal inventory, but sonographic analysis is still open. Future projects should also clarify the prey-list in concern to local fauna. Comparisons of appearance, vocalization, and behaviour of *Strix davidi* and *Strix uralensis* confirm that these species match in main characters, and are to merge in a "super-species".

Population dynamics and conservation status of the Western Burrowing Owl *Athene cunicularia hypugaea* in the United States and Canada: a 20-year update

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Keywords: Western Burrowing Owl; population decline; fossorial mammals; standardized avian counts

Western Burrowing Owls (WBOs) are grassland specialists distributed throughout western North America, primarily in open areas in desert, grassland, and shrub-steppe ecosystems. They largely are dependent on the presence of fossorial mammals where burrows are used for nesting and roosting. This owl species has been the focus of much research, monitoring, and conservation efforts since the first indications of population declines in the 1980s. Despite this focus, burrowing owls remain endangered in Canada, threatened in Mexico, and not yet listed but continuing to decline in the United States. I examined the population dynamics of WBOs using two major standardized avian counts (BBS, CBC) and reviewed the conservation status of WBOs as I did 20 years ago to assess changes occurring over this time. In the US, burrowing owls are still listed as endangered, threatened, or a species of concern in many western states. BBS data for the US and Canada reveal that the 1966-2011 trend is slightly more than a 1% loss per year. Almost all western US states continue to show declining numbers (0.2-4.9%), with the exception of Arizona, Nebraska, New Mexico, and Wyoming, and a few more states have listed WBOs in recent years. CBC data for the US indicate that relatively few WBOs are seen on CBCs (0.03-0.05 owls/party hour), limiting its use. The elimination of burrowing mammals through control programs and habitat loss appears to be the primary factor responsible for WBO declines. Thus, I suggest that a major way to conserve WBOs is to protect burrowing mammals and their habitats, which should include eliminating control programs and placing real limits on changing land-use for agricultural and other development. Further, conservation statuses of WBOs in the US should be revisited and adjusted to more accurately reflect their continuing declines.

Global assessment of overlap between owl species ranges and protected areas

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Keywords: owls; distribution maps; protected areas; conservation

As part of the Aichi Biodiversity Targets agreed upon during the Convention on Biological Diversity, governments around the globe have agreed to increase the total global protected area network to 17% by 2020 as well as prevent further loss of known threatened species. Understanding the distribution and coverage of current protected areas in relation to species distributions is critical for planning new or expanded protected areas. As apex predators, owls can play a significant role in providing for broader ecosystem-level conservation and analysis. Because they are excellent indicators of biodiversity and ecosystem health, owls can be used to identify conservation targets and at-risk areas. By studying and conserving owl species, larger biodiversity conservation goals can be achieved. The goal of this project was to evaluate the distribution of global owl species with respect to current protected area boundaries, with a specific focus on species of conservation concern or data-deficient species. Previous work has identified the distribution of endangered or otherwise vulnerable owl species, as well as those considered data-deficient by IUCN. Using GIS analyses, owl species distribution maps for >200 species were layered with current protected area data to calculate the amount of each species range that falls within a protected area. This current analysis evaluates where and which owl species of conservation concern, of least concern, or data-deficient owl species currently are found within, and outside of, protected areas. These results provide locations where protected area establishment and expansion could provide critical protection to endangered and/or threatened owl species. Further analysis could also consider land-use changes and threats to species such as climate change in addition to protected area status.

Owl conservation efforts in Nepal

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Keywords: conservation camps, ethno-owl survey, hunting, Nepal owl festival, trade

Nepal has achieved tremendous conservation success over the last decade, especially with in Tiger *Panthera tigris*, One-horned Rhinoceros *Rhinoceros unicornis*, Snow Leopard *Panthera uncial* and some vulture species. However, owls have garnered the least attention in the country. Only a few studies have been done on their status and the threats they face in the country. Nepal has also been used as a hub for illegal wildlife trade at the international level, making owls in the country vulnerable. Hence, we have been conducting targeted conservation measures in the country since 2008 with an aim of bringing the plight of owls to the fore. We have employed a variety of methods including multimedia presentations, publications of conservation materials, use of both print and electronic media and questionnaire survey to try and make people aware about the situation of owls in the country. To date, one baseline study, 500 conservation camps (35,000 students and public), 13 radio programs including BBC Nepali services (having 6 million listeners), 1500 posters, 3000 pamphlets, 100 t-shirts, one documentation of ethno-owl survey, six Nepal Owl Festival events, more than 50 rescue events, one preliminary assessment of hunting and trade dimension have been completed. Nevertheless, the establishment of an Owl Conservation Center, a detailed assessment of hunting and trade of owls, studies of ethno-owl relationships, and transboundary control efforts are important for the long-term conservation of owls in Nepal.

The Role of Small Non-government Organizations in Owl Conservation: Barn Owl Trust - A Case Study

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Keywords: Barn Owl Trust, Non-government Organization, Charity, Conservation

Nature conservation was our hobby. The goal was simply to re-establish Barn Owls *Tyto alba alba* on one farm. To find out if there were any Barn Owls nearby we interviewed farmers within 2 km and searched for pellets. We put up a poster saying "WANTED – Barn Owl Information" which led to local newspaper and TV publicity. As a result, people started to report Barn Owls and asked for advice. This led to more site visits, more local owl surveys, more publicity, and the erection of nest boxes. Friends helped us to raise a little money. Within three years we became a small group of volunteers. It was suggested that we register a charity and call it the "Barn Owl Trust".

Two years later we began investigating the effects of 'barn conversions' on local Barn Owl populations. This led to our first scientific paper and a booklet distributed to every Local Planning Authority in the UK. Hundreds of sites have been visited, thousands of enquiries received and countless projects carried out, including county Barn Owl surveys and training courses. After 25 years we published the 'Barn Owl Conservation Handbook'. We have campaigned for improvements in the design of major roads, reductions in rodenticide poisoning and improvements in nest box designs. In 2007 our work received Royal recognition.

Funded almost entirely by donations, we currently have twelve employees. We liaise with individuals and groups, volunteers and professionals both in the UK and abroad. Our website now receives 3-4,000 visits a day.

The anthropogenic threats faced by owls across Planet Earth are enormous, government funding is almost always inadequate, and Big Money is almost always selfish. Ultimately, we will fail to conserve owls unless we engage people in the cause of nature conservation. The Barn Owl Trust is an example of how ordinary people can make a difference.

"Why Hoot?" – An evaluation of motivations and scientific attitudes of citizen science owl surveyors in Manitoba, Canada

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Keywords: citizen science; volunteers; participation; motivations; amateur naturalists

Manitoba initiated a spring volunteer nocturnal owl survey in 1991 to provide citizens with a beginner-friendly personal experience with owls to make wildlife conservation more relevant to them. Other objectives included gathering data on owl numbers and distribution over a long-period; owl survey methods and results are presented separately at this conference. In November, 2015, we surveyed participants of the ongoing 25-year effort to better understand surveyors, including their intrinsic/extrinsic motivation, participatory behavior and attitudinal and other changes (i.e. in their relationship with science and ecology) to help researchers design contributory style projects to recruit and retain citizen scientists to gather wildlife data and to achieve desired educational outcomes. Results on surveyor age and gender demographics, participation behavior, motivations, benefits and personal consequences, reasons for leaving, scientific attitudes (literacy, environment, and conservation) will be presented. Results suggested that surveyors developed or deepened their personal relationships with nature through participation, which was a primary objective of the survey. However, interpersonal dimensions or social aspects of surveying most strongly motivated participants and positively influenced recruitment, survey experience, and retention. Experiencing nature and encountering owls and other wildlife were the next most common benefits. Many respondents also stated that they enjoyed experiencing nature socially. Learning was rarely cited as a motivation, although gaining knowledge was the most common reported benefit. Respondents considered themselves scientifically literate and were highly educated. Marketing citizen science projects as social opportunities may help attract and retain more volunteers, ensuring long-term sustainability of programs. Engaging new participants in activities that increase their ecological knowledge and

awareness and that gather data will help conserve owls and other wildlife. Future research on interpersonal dimensions as motivators of citizen science participants including the role of social networks, are recommended.

Impact of forestry on a population of Tawny Owls *Strix aluco* in north-western Switzerland

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Keywords: Tawny Owl; *Strix aluco*; forest management; declining populations; Switzerland

For the last ten years a population of Tawny Owls *Strix aluco*, in the Ajoie forest, canton of Jura, Switzerland, shows that forest management, as practiced today, is counterproductive for the infrastructure and trophic needs of the species. Forests are now intensively exploited to supply a large volume of wood chips to meet the demand for new remote heating plants. A significant amount of hardwood and softwood logs are currently harvested while the timber market has been losing ground in recent years. The foresters are at work permanently, selecting trees in autumn and winter and logging in spring and summer. However, it is not the constant disturbances of the forests that really influences the species but the impact on the environment.

The felling of trees with natural cavities has a clear impact on the density of breeding pairs. It is especially the opening to the light of whole sectors of the forests which is worrying today. After the logging the ground is covered very quickly with blackberries *Rubus fruticosus*, preventing access to the owls to their essential food i.e. the yellow-necked mouse *Apodemus flavicollis*, the wood mouse *Apodemus sylvaticus*, and the bank vole *Clethrionomys glareolus*. Despite the fact that the placement of nest boxes helps maintain and even encourage the Tawny Owl population, this activity is sustainable only when there are volunteer ornithologists to manufacture and maintain them.

If we are willing to preserve the species in the Jura forests a clear compromise between the forestry economy and the protection of the environment is required. The creation of new forest reserves, groups of old timber or habitat trees is to be welcomed, but these measures recently enacted by the Swiss federal and cantonal administrations are ineffective in halting the loss of forest biodiversity by modern forest management. Forests are continually deteriorating and their biodiversity is rapidly disappearing globally. As far as forest management is concerned, a mental shift is needed urgently.

Culture

Understanding the illegal owl hunting and trade dynamics in Nepal

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Keywords: Barn Owl; hunting; seizure; trans-boundary conservation; illegal trade

The illegal hunting and trade of owl species is common in Nepal. Interviews with key informants, information discussion, the documentation of seizure records and a literature review were done to collect information on owl hunting and trade in the country. Information collected by visiting about 40 districts in Nepal noted that at least 2000 individual owls of various species were either hunted or traded both within and outside the country. Hunting and trade was found to be common throughout Nepal. People were found to use various methods (at least six) to hunt/catch them. The hunting intensity varied among species, with four having the highest: Barn Owl *Tyto alba*, Rock Eagle Owl *Bubo bengalensis*, Spot-bellied Eagle Owl *Bubo nipalensis* and Brown Fish Owl *Ketupa zeylonensis*. The price started from $100 US dollars at the level of the local collector, and gets up to $2000-3000 US dollars when it reaches the top supplier. Species are traded to India or China. Detailed investigations on owl hunting and trade are urgently backed up by trans-boundary conservation efforts.

Social perception about the role and abundance of the Barn Owl *Tyto alba* in an agricultural landscape in the North of Spain

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Keywords: Barn Owl; *Tyto alba*; Social Perception; Population

The Barn Owl *Tyto alba* is particularly abundant in the southwestern Europe, yet it is anecdotally perceived to be in decline by inhabitants of agricultural landscapes. Sampling records appear to agree with this perceived population decrease, pointing to human activities - e.g., dense road networks, changes in agricultural practices - as potential causes. However, nocturnal raptors are difficult to sample and human perception of environmental changes can be affected by distorted memories. Thus, we aim to determine the relationship between social perception and actual barn owl's population density.

Our study was conducted in an agricultural area of Navarra (Spain) comprising 54 municipalities in 2,500 km^2. We surveyed 229 inhabitants from 42 of these municipalities, focusing on people in direct contact with rural environment (e.g., farmers, hunters, shepherds). Surveys gathered people's knowledge and perception about species' biology and population trends. To determine barn owl population trends, we created an indirect registry of its historical presence in this area by reviewing periodical reports from the Spanish Ornithological Society (SEO) and barn owl pellet records from the Museum of Zoology of the University of Navarra spanning 40 years.

Results revealed that the surveyed population report seeing fewer individuals than in the past. Farmers and hunters identify barn owls better than the rest of the surveyed population and are knowledgeable about the species' feeding and nesting habits, which provides reliability to the data. Based on museum's pellet records, old sampling sites linked to urban areas that were abandoned, while most new sites were linked to rural areas and documented the species presence.

Pellet analysis revealed that barn owls have disappeared from urban areas, which is consistent with survey results. Our study provides information about the species' presence outside of urban areas, but not about abundance. Future work should focus on this aspect.

From cures to curses - Owls and their place in traditional healing in Southern Africa

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Keywords: traditional medicine; ethnobiology; South Africa; folklore; healers; mythology; owls

Traditional medicine or "muthi" is a billion Rand Southern African industry. The apartheid era placed restrictions and censure on this industry which forced most traditional healers and sangomas to operate in secrecy (Suppression of Witchcraft Act of 1957). The post-apartheid era has allowed traditional healers and the use of traditional medicine to venture into the light. Traditional medicine markets or '"muthi" markets are now found in all major cities and throughout rural villages within South Africa. The decriminalization of the "muthi" markets and sangomas in post-apartheid South Africa has resulted in calls from traditional healers to be afforded greater recognition within the medical fraternity. These calls extend from the ability to advertise themselves as doctors to the issuing of valid doctors notes for illness related absenteeism within the work place. As in many cultures globally, owls have featured prominently in South African folklore and mythology. The use of owls and owl parts, although acknowledged, has to date not been qualified nor quantified within the traditional healers' "muthi" chest. Through site visits to "muthi" markets in South Africa and the participation of traditional healers in a simple questionnaire, the uses associated with owls and their body parts have emerged. In addition, insight has been gained relating to the collection and identification of owls by these healers. In Southern African "muthi" owls are distinct as they are used for both traditional cures relating to headaches, insomnia as well as for spiritual curses and "witchcraft". With the influx of both legal and illegal migrants arriving in South Africa through porous borders, it is believed that the reliance on traditional healers and their remedies will continue to rise. The conclusion of this discussion will explore possible mitigation including the potential for wildlife rehabilitation centers and zoological gardens, who routinely receive owls which require euthanasia, to contribute to this market in a way that reduces the exploitation associated with the wild harvesting of owl species by traditional healers.

Perceptions and beliefs about owls in Turkey

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Keywords: ethnobiology, owls, culture, Turkey, interviews, beliefs

During 2015 and 2016, we conducted interviews with 207 Turkish residents (ages 18 to 60+ yrs) to ask them about their ecological and cultural beliefs about owls. All respondents considered owls as birds, had seen and heard owls, and 93% stated that they had owls near where they live. The majority correctly characterized owl diets and general habitats. General discussions and inquiries during our project revealed that owls were considered as ominous in the old Turkish culture. Our data showed that some (33%) of the respondents still consider owls as scary/dangerous or bad omens. While many respondents gave phrases like: "I have heard from elders that owls are ominous; owls bring death and bad luck", only 27% actually believed the myths and stories to be true. Still, the majority (62%) stated that they were scared/frightened, when they saw or heard owls, or heard people talking about them. We found that long-held beliefs about owls are beginning to change, as the majority (75%) considered owls important for the environment, and 56% indicated that owls should be protected (36% were “not sure”). Owl-themed items (e.g. clothing, jewelry, notebooks) are commonly found in the marketplaces now. The Research Association in Turkey, annually gives out prestigious “BaykuşÖdülleri” (Owl Awards), to reward successful marketing and social survey research industry professionals. While Turkey has a diversity of owl species, owl populations have also been affected by habitat degradation, unconscious-hunting, poisonings and anthropological factors. In general, Turkish citizens seem very aware about the presence of owls in their area but they were less aware about the ecological, agricultural and aesthetic importance of owls.

Social aspects as part of conservation targets for owls in Greece: Data analysis from cultural history and recent surveys

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Keywords: social beliefs, survey analysis, historical review, owls, Greece

The present work was conducted in Greece as part of an international effort organized by the Global Owl Project (GLOW) dedicated to "Owls in Myth and Culture". It explores social and cultural aspects related to wildlife, both from a historical research as well as from survey questionnaires from mainland and insular Greece. Main goal is to include social aspects in conservation and management decisions, and outline basic trends from a historical point of view in representative literature, until recent beliefs. Methodology was based in a threefold approach: 1) extensive historical review for the last 5000 years starting from the Bronze Age, and including Minoan, Mycenaean, Dark Age, Archaic, Classical, Hellenistic, Greco-Roman, Byzantine, Ottoman and Modern Greek period, 2) a multivariate assessment through ordination techniques for the historical framework, 3) statistical exploration of trends for the current survey data.

In five millennia of Greek history, the use of cultural expressions and beliefs followed three distinct levels where owls symbolized: (i) The simple biological description of the species, mainly in Minoan and Bronze Age, (ii) Bad omens and unearthly bringers of bad news who induce fear, mainly in the Mycenaean and Modern Greek period, (iii) Power, divinity, protectors of simple people and cities, good omens, wisdom and knowledge, mainly in the Archaic-Classical-Hellenistic period.

Recent survey findings, suggest that conservation targets should: (i) Raise environmental awareness for owls towards age classes of 20 to 50 years old, where basic information still lacks, (ii) Urge children in urban centers to contact and observe owls in their natural environment, (iii) Inform that owls are beneficiary since an important percentage still believes that they are not,

(iv) Campaign in small urban areas about the importance of owls in a biodiversity context and as indices of habitat and resources quality, (v) Stress that owls, although they were often used in historical traits as wise and powerful, they are just biological beings in need of research, conservation and protection, (vi) Introduce the context of artificial nest boxes as a possible conservation action, specifically when relocation is necessary due to undesired nesting within human constructions.

Owls in Myth and Culture – Interviews from Slovakia

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Keywords: Ethnobiology, owls, culture, Slovakia, interviews, beliefs

During 2017, I conducted interviews with 128 Slovakian residents (ages 6 to 60+ years) to ask them about their ecological and cultural beliefs about owls. Of the interviewees, 96% had heard an owl call, and 98% had seen an owl; 84% stated that there were owls near where they lived. The vast majority correctly classified the main prey of the owls, as well as the owls' nesting habitat and nesting places.

Predominant among their beliefs about owls were that owls were 'wise', 'helpful or bring good luck', or were 'just birds.' Only two respondents (1.6%) viewed owls as being 'scary/dangerous' and 'bad omens or bring bad luck.' Some 38% stated that they knew a story or legend about owls (42 said did not know of any stories or legends; 20% were not sure), but only 7% believed that they were true (61% said that did not believe the stories/legends; 22% were unsure).

Interestingly, 98% said that owls were important for the environment, and 94% stated that owls should be protected. The predominant view was that owls were beneficial, harmless, and important. Overall, Slovakian citizens seem very aware about the presence of owls, their ecological needs, and had a positive view of owls.

General knowledge and beliefs towards owls in the Calakmul Biosphere Reserve (Campeche, México): an approach to improve conservation efforts

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Key words: owls, knowledge, conservation, superstitions, Calakmul.

The study of birds in culture and the incorporation of traditional and ecological knowledge of people in environmental conservation should be strongly considered for the protection of avifauna, since conservation efforts are likely to be unsuccessful without the support of local communities. Owls have been surrounded by a number of beliefs which vary between regions and countries, from being considered announcers of misfortune to symbols of wisdom. The general knowledge and cultural perspectives regarding owls were explored in a total of 124 adult participants by conducting questionnaire-based research in two localities belonging to the Calakmul Biosphere Reserve (Campeche, México): home of six owl species, and a culturally and ecologically distinct area. The Mayan word "X'ooch" is used to name the Barn owl (Tyto alba), species which was particularly linked to superstitions such as bad luck and forthcoming misfortune. However, most of participants did not agree with these superstitions, which were mostly transmitted by the respondents' family members. Few interviewees (12%) claimed to know about owl killings in the area as a result of amusement and superstitions. Owls were mostly classified as "harmless" (60%) and "ominous" (22%) birds. The knowledge regarding habitat and nesting sites was good. However, fruits were inaccurately listed as an owl food source. Although cultural or superstitious aspects did not seem to be negatively impacting owls in Calakmul, there is a clear necessity to increase the knowledge about how beneficial owls are and to encourage people to get involved in conservation efforts, as well as prevent any actions that might negatively impact the owls' survival. The information gathered will be useful to develop more specific - and therefore more successful - educational programs through giving deserved importance to the traditional and cultural knowledge of people in Calakmul.

Methods

Using bioacoustics to study habitat use and vocal behavior of Barred Owls, Boreal Owls and Great Horned Owls

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Keywords: autonomous recording unit; audio; detection; Alberta

Bioacoustics is the study of sound produced by animals, and has gained momentum with technology able to record sound autonomously in many different environments. Autonomous recording units (ARUs) are increasingly used to research and monitor birds because of the benefit of reduced observer bias and the ability to collect data over longer time scales. We used ARUs to study owl habitat use and vocal behavior by passively recording any owls calling during the breeding season. We scheduled ARUs to record for 10 min every hour on a 24 hr basis, and deployed the units throughout northeastern Alberta from mid-March through to late-May of 2013, 2014, 2015 and 2016. We scanned all recordings collected over those four breeding seasons using automated recognizers we successfully developed to detect territorial calls of Barred Owls *Strix varia*, Great Horned Owls *Bubo virginianus*, and Boreal Owls *Aegolius funereus*. Due to the relatively low detection rates of owls from listening to recordings, we found the automated recognition approach was highly useful for studying owls. We found that territorial vocal activity was highest for Barred Owls and Boreal Owls 2-5 hr before sunrise, and for Great Horned Owls vocal activity peaked 5 hr before sunrise and was high 1-5 h before sunrise. Barred Owls called occasionally during daylight hours, but this was rare for Great Horned Owls and Boreal Owls. Locations of owl detections indicated that Barred Owls were more likely to be found calling in mixed-wood forests, Boreal Owls were more likely to be found calling in coniferous forests, and Great Horned Owls were equally likely to be found calling in all habitats surveyed. This research contributes to our understanding of the behavior of these three owl species. Our

findings have practical implications for conducting passive surveys of owls and demonstrate the utility of new bioacoustic technology to study and monitor owls.

Snowy Owls sit on high - Selection of vantage points revealed by number of owl pellets

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Keywords: Snowy Owl; *Bubo scandiacus*; pellets; vantage points; hunting behaviour

In 2007 we located four Snowy Owl *Bubo scandiacus* nests in Finnmark, northern Norway. The nests were spaced out almost along a straight line, spanning 4.7 km between the outermost nests. The nests were found in a rocky, undulating mountain terrain above the tree line. Field work was carried out in the period 3-17 July, when the eggs had hatched and the owls were feeding chicks. We collected pellets surrounding nests 2, 3 and 4. In 2011, Snowy Owls nested in the same area again, and by DNA analyses of moulted feathers one male was shown to have fathered at least some of the chicks in both nest 2 and 3 in 2007. Pellets in the vicinity of these two nests were thus treated as belonging to one male´s hunting area. All vantage points in the surrounding terrain of the nests where hunting males had been observed were visited and searched for pellets. All found pellets were counted, collected and bagged separately from each location. Vantage points were plotted using a Garmin GPS, and height above sea level noted. A total of 309 pellets were collected from 35 vantage points. The number of pellets found at vantage points spanned from 1 to 39 (mean 8.8 per point, median 6). While the nests were located 513, 522, 524 and 529 m asl (mean 522 m), the vantage points with pellets were located from 515 to 590 m asl (mean 550.2 m, median 548 m), with the highest number of pellets found at the highest vantage points. The steady increase of pellets with higher elevation above the nest site indicate that Snowy Owls prefer to sit on the highest vantage points surrounding the nest. Although some pellets may have been cast by both sexes before the females started incubating, most pellets were most likely cast by males.

Using the MP3-trap technique to capture male Burrowing Owls

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Keywords: Burrowing Owl; trapping; methods; MP3; audio

During the field seasons of 2010 thru 2017, we used MP3 players and small speakers, placed inside nests, cache or temporary burrows, in conjunction with swing-door traps, to capture 1500+ male Burrowing Owls *Athene cunicularia*. In prior years, we had used bownets baited with mice to capture males, resulting in the capture of about 80% of the males. This food-based solicitation did not work well on males with great hunting skills or easily available prey. So, we switched to using a territorial-based solicitation framework, starting with a wildlife caller and bownet or walk-in trap placed at nests or male cache burrows. We subsequently began using an MP3 player and folding speaker. MP3 players and folding speakers were placed inside the males' food cache/roost burrow, or if such a burrow was not present, we would add a temporary 'fake' burrow (e.g., 35 cm section of 15 cm plastic drain pipe). At the entrance of these burrows we would place a swing-door walk-in trap. The MP3 player/speaker would play the "coo-cooo" contact call of the male; volume would be low, so that it could only be heard from 3-4 m away. The intention was to replicate the calling of a pesky, intruding, sub-dominant male. The MP3-trap technique was highly efficient. In essence, the MP3-trap allowed us to capture nearly all of the males we attempted capture on, and in substantially less time and effort than bownets required. In 2013, DHJ and colleagues used this technique to capture 130 adult male owls on study areas in six US states. We recorded trap times and capture rates. In 2014 we recorded the amount of time it took to capture every male and female adult owl on one of our demographic study areas (n=120 owls). We also captured un-paired floater female owls drawn in by the male calls on the MP3 player. In this presentation we discuss the specific methods and results of this trapping technique.

Snowy Owl hunting behaviour and prey spotting distance revealed by vole lures

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Keywords: Snowy Owl, prey detection, flight distances, lure

When Snowy Owls *Bubo scandiacus* turned up in Finnmark, northern Norway in summer 1993, a vole lure on a line was used to test if the owls could be tricked to approach and attack the lure in the same way as Great Grey Owls *Strix nebulosa* do (Nero 1980). Lure testing was conducted during 11-15 July. The lure was placed on the ground some 5-10 m away from me when an owl was spotted more than 100 m away. When the owl looked towards me, I pulled the line to make the lure move. The reaction of the owl was observed through a spotting scope, and noted as positive when the owl stretched and bobbed its head, and negative if no obvious reaction could be seen. I was sitting on the ground (4 times) or in a car (7 times) when pulling the lure. A total of 11 tests were carried out on 9 different individuals (7 males and 2 females). All males detected the vole lures from distances up to at least 1 km. The two females did not show any interest in the lures. Two males came in, one from at least 500 m and the other more than 100 m distance, and grabbed the lure, while a third approached from at least 350 m distance to ca 100 m away. A male which sat 1000-1100 m away clearly detected the lure movements, but did not fly the long distance for an attack. Hunting behaviour was observed in eight individuals when they were not disturbed by humans, and 29 flight distances were noted. The owls seemed most often to fly 50-200 m between vantage points, (mean distance 158 m, median 100 m). Short flights of 10-40 m were linked to predation attempts, presumably on lemmings or voles.

Owls in the realm of avian anatomy

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Owls are one of the most spectacular groups of birds regarding morphological adaptations in relationship with their unique way of life. Their refined adaptations in e.g. hearing capabilities, vision, flight characteristics, or digestive system are exemplary in ecomorphology, i.e. the science that links ecology and behaviour to how organisms are built. However, many more birds have structural characteristics which enable their ecological performance. We propose to present some of these traits of owls and compare them to other avian groups, which may or may not show ecomorphological features of the same structure. We offer this presentation as we are currently working on the first Avian Ecomorphological Atlas, an anatomical atlas celebrating the diversity of the avian body in relationship with bird performance and ecology. Part One focuses on all European bird species, but we will continue to work on this project until all continents are covered. This project, for which we dissect, measure, photograph, and draw a few hundred species from Europe alone, takes an enormous amount of time and effort. Besides answering many scientific questions, the goal of publishing the Atlas is to reveal and present the existing variation in avian anatomy to a broader audience and to evoke curiosity and admiration for the lives of birds. Indirectly, this may increase public support for and understanding of nature conservation issues, especially those concerning birds. This presentation will familiarise the conference attendees with our objectives, and includes a request to gain access to stocks of dead birds that we may use or rare photo images of particular aspects of bird behaviour that are tightly linked to structural adaptations.

Evolution, Taxonomy and Phylogeny

Omani Owl *Strix butleri* – Its taxonomy, distribution, vocalizations, diet, and relationship to Desert Tawny Owl *S. hadorami*.

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Keywords: Strigidae; *Strix*; taxonomy; vocalizations; molecular identification

When a *Strix* owl with unknown vocalizations was discovered in Oman in 2013, it led to the realization that there are two species of desert-dwelling *Strix* owls in the Middle East, not one as had been assumed for 135 years. The owl from Oman represented the rediscovery of *S. butleri*, described by Hume in 1878 based on a single specimen from Pakistan. The other, more familiar species has now been described as the Desert Owl or Desert Tawny Owl *S. hadorami*. In order to clarify the relationship between these two species, I summarize the results of several studies involving vocalizations, mtDNA, geographical distribution, and the study of pellets. The two species differ clearly in all of their vocalizations. *S. butleri* is currently known to occur in the Al Hajar mountains of northern Oman and the United Arab Emirates, as well as in at least three widely separated provinces of Iran. A cytochrome b sequence from Oman was identical to that of the holotype from Pakistan but showed a 9.9% difference from *S. hadorami*. The latter occurs in southern Oman, Yemen, Saudi Arabia, Jordan, Israel, and the Red Sea coast of Egypt (including Sinai) and Sudan. Claims of an insular *Strix* owl on Socotra remain unverified. 10 pellets collected from northern Oman showed that *S. butleri*, like *S. hadorami*, is a predator of small mammals, geckos and scorpions. This study underlines that there are still owl species in well-studied regions about which almost nothing is known. *S. butleri* has special characteristics that make it unusually difficult to detect. Despite having been discovered as long ago as 1878, it was only in 2013 that we started to know anything about its vocalizations, distribution and ecology.

Evolution and phylogeny of owls

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According to genomic analyses of birds (Prummer *et al.* 2015) owls were confirmed to be a monophyletic group which evolved in a clade of landbirds in vicinity of diurnal raptors and mousebirds. We have used nucleotide sequences of mitochondrial and nuclear DNA to infer the phylogeny of Strigiformes, covering more than 70% of extant species. Latest splittings and taxonomic changes will be discussed. The phylogeny will be used to infer the evolution of behavioural and morphological characters.

Barn Owl *Tyto alba* colour cline in Europe: The exception proves the rule

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Keywords: Barn Owl; colour cline; local adaptation; population genetics

In Europe, the Barn Owl *Tyto alba* displays a pronounced clinal variation in colouration. In southwest Europe individuals have mostly white underparts, whereas in northeast Europe they are dark rufous. It was previously thought that this gradient originated from two different subspecies that recolonised Europe after the last glaciation hybridizing in Central Europe. However, we have shown that the European population actually derives from a single expansion route from northern Africa through the Iberian Peninsula. Furthermore, the difference we observe today in coloration is not a simple consequence of the colonisation. Rather, the rufous colour is a recently evolved phenotype actively maintained by local adaptation. The particular selective agents behind it are not fully understood yet, although it is related to the environmental gradient along Europe, with rufous Barn Owls being adapted to environmental conditions prevailing in the north and east.

In Great Britain and Ireland however, Barn Owls are considerably whiter than their mainland counterparts. Given what we see in continental Europe, one would expect them to be selected for a darker coloration at such longitude. Surprisingly, individuals in these islands have even whiter underparts than those of the Iberian Peninsula. To investigate how these populations evolved so differently from the mainland and which processes are involved in maintaining this difference, we are using population genetics tools and computer simulations. Preliminary results show that, in addition to the phenotype, genetic divergence between these groups is also quite pronounced. Further work is currently underway to retrace the demographic history responsible for the observed colour patterns and to explore whether a particularly strong effect of either drift or selection is maintaining it.

Evolutionary dynamics of colour polymorphism in Tawny Owls *Strix aluco*

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Keywords: adaptation; environmental change; host-parasite interaction; melanism; plumage colouration

A major goal in ecology and evolutionary biology is to understand how environmental change generates a rapid phenotypic response through evolutionary and ecological processes. A particular and currently important form of environmental change is the ongoing global change in climate. There is increasing evidence of micro-evolutionary changes associated with climate and other evidence on selection driven by variation in climate. However, little is known how these are linked and what the underlying physiological adaptations are. A classical way of investigating such adaptation to different environments is the study of genetic colour polymorphism in natural populations. This is because theory predicts that colour morphs are adaptations to different environments.

We have studied Tawny Owls *Strix aluco*, which display a highly heritable pheomelanin-based colour polymorphism in their plumage ranging from pale grey to reddish-brown. In this talk we present individual-based long-term data on Tawny Owl colour polymorphism from a Finnish population from 1978 onwards. I will first show that the reddish-brown morph has lower survival than the grey morph under cold and snow-rich winters and that this selection against the reddish-brown morph has changed as winter climate has become milder. Second, we present data documenting that this climate-driven selection has translated into a rapid increase of the reddish brown morph in Finland. Third, we present the main findings from our studies showing the putative mechanisms of this climate-driven selection dealing with colour morph-specific variation in plumage insulation, sensitivity to parasites and aging (telomere dynamics). Lastly I

will present some future prospects of the project including studies of Europe-wide geographical variation in Tawny Owl colour polymorphism.

Physiology

Protein sources for egg production: why do diurnal raptors and nocturnal owls respond differently to forest degeneration?

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Keywords: amino-acids; egg production; protein sources; Tawny Owl; Sparrowhawk

The Netherlands is second after the USA in the export of agricultural and dairy products, which comes at a high price for the Dutch environment and biodiversity. In order to document the effects of nitrogen deposition and soil acidification therefrom on forest fauna, we study several bird species (e.g. Great Tit *Parus major*, Sparrowhawk *Accipiter nisus*, Tawny Owl *Strix aluco*) on the Veluwe, a large forested area in the Netherlands. Effects of forest degradation include large-scale tree mortality of common oak *Quercus robur*, lowered protein synthesis in trees, shifts in the composition of free amino-acids in trees, severe calcium deficiency in Great Tits, and amino acid deficiencies in reproducing Sparrowhawks. Raptor species have strongly declined, but, surprisingly, Tawny owls have not. We hypothesized that this was due to amino-acid producing caecal bacteria present in (Tawny) owls, which lack in diurnal birds of prey. In contrast, Sparrowhawks break down breast muscle tissue to complement dietary amino-acid deficiencies. I compared amino-acid compositions of owl eggs, Wood Mice *Apodemus sylvaticus*, caecal sacs, owl breast muscles, and Sparrowhawk eggs and breast muscles to determine whether protein amino-acid composition varies with protein source, and to compare egg amino-acid requirements between Sparrowhawks and Tawny Owls. Amino-acid measurements were done commercially by a certified (human) food-quality research facility (TNO). Results show that wood mice and breast muscle tissue of both bird species were short in several essential amino-acids, up to -56% for cysteine, compared to egg requirements. The amino acid content of the caecal sacs was also low in cysteine but only -16%. In addition, caecal sac amino acids are renewed continuously, whereas breast muscle protein is a limited source of amino-acids. As

Sparrowhawks lack caecal sacs, they are more vulnerable to dietary amino acid shortages in degenerated forests than Tawny Owls.

Monitoring

Insights into the distribution of Pueo or Hawaiian Short-eared Owl: utilizing citizen science to aid monitoring surveys

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Keywords: *Asio flammeus sandwichensis*; Short-eared Owl; distribution; citizen science; monitoring; Hawaii

The Pueo or Hawaiian Short-eared Owl *Asio flammeus sandwichensis*, once common across the islands, is now state-listed as Endangered on O'ahu. Three characteristics make this owl particularly vulnerable: (1) reliance on intact grasslands; (2) unpredictable food resource (preference for a diet of small mammals, which often vary substantially spatially and temporally); (3) and low site fidelity (with variable seasonal and annual movements). These characteristics also lead to great challenges in monitoring population size and distribution. Although the Pueo has been recorded in a variety of habitats in the Hawaiian archipelago, including wet and dry forests, it is most commonly detected in open habitats such as grasslands, shrublands, and montane parklands, including urban areas and those actively managed for conservation. However, documentation is lacking for several factors: historical population data, basic life history characteristics and the species' key habitat variables, which are difficult to determine. In order to amend this situation, we created a project, in partnership with the Hawai'i Division of Forestry and Wildlife, to improve population monitoring and define habitats important to population stability. Public participation was engaged through a citizen science component. A website and several other materials were created for public distribution. In addition, information was gathered by several volunteers. Owl surveys and habitat use characterization, combined with the aid of citizen science, resulted in improvements for monitoring and new insights into the population and distribution of the Pueo.

An evaluation of 25 years of volunteer nocturnal owl surveys in Manitoba, Canada

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Keywords: owl surveys; citizen science; population monitoring; distribution; relative abundance

Manitoba initiated a spring volunteer nocturnal owl survey in 1991 to provide citizens with a personal experience with owls and thereby make wildlife conservation more relevant to them and to address a gap in existing land bird monitor programs which under report owls. Other survey objectives included to determine owl species distribution, relative abundance, population trends, and habitat associations. Surveyors were trained to identify owl calls, and from 1991-1999 both passive listening and owl call playback were used to survey owls from point locations spaced 800 m along linear transects. The use of playback ceased in 2000 and owls were surveyed by passive listening only at intervals of 1.6 km. An estimated 6,335 owls of 11 species were detected on a total of 32,549 km of linear point count surveys over 25 years (1991 to 2015) by 910 surveyors. Northern Saw-whet Owls *Aegolius acadicus*, Great Horned Owls *Bubo virginianus*, and Boreal Owls *Aegolius funereus* were most numerous, accounting for 75% of detections. The Endangered Burrowing Owl *Athene cunicularia* was the only Manitoba owl species undetected. Owl species detection rates varied annually and cumulatively ranged from 0.08 to 0.36 owls/km surveyed. Survey methodology, owl species detection rates, and a summary of volunteer participation and retention over the survey period will be presented. A summary of the use of this project's citizen science data in published papers, graduate theses, species conservation status assessments, and a bird atlas project will also be presented. Suggestions for new approaches to facilitating and retaining volunteer participation and growth and maximizing data use for this and other citizen science projects will be discussed.

Status and monitoring of Short-eared Owls *Asio flammeus* in North and South America

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Keywords: Short-eared Owl; *Asio flammeus*; status; trends; monitoring

The breeding range of Short-eared Owl *Asio flammeus* in North America includes all 13 Canadian provinces and territories, and approximately 25 U.S. states; the wintering range extends south to northern Mexico. Short-eared Owl is listed as a species of special concern in Canada under the Species at Risk Act, but is not covered under the U.S. Endangered Species Act, although NatureServe has ranked the species as imperiled or critically imperiled in 21 states. In South America, Short-eared Owl is a permanent resident of most of Chile, Argentina, Paraguay, and Uruguay, and parts of Brazil, Peru, Colombia, and Venezuela; it is considered vulnerable in Argentina and vulnerable to endangered in parts of Brazil. Conservation status is highly influenced by assessment of population trends, which are derived from multiple sources, each of which has advantages and limitations. In North America, both the Breeding Bird Survey and Christmas Bird Count reveal a widespread decline over the past 50 years, especially in the midwest and northeast U.S. Several second-generation state and provincial breeding bird atlases have shown a reduction in occurrence of Short-eared Owls compared to initial results approximately 20 years earlier. Widespread declines in frequency of observation are also reflected in eBird data. Overall though, traditional multi-species monitoring programs have not been very effective at documenting Short-eared Owls. The Western Asio Flammeus Landscape Study (WAFLS) is the first regional monitoring effort specific to this species, using standardized surveys and modeling the results using occupancy analysis. Over its first three years, it has already yielded valuable data on population fluctuations, and the WAFLS approach can be readily adapted to other regions. In South America, monitoring to date has been more limited and

further research is required, but it is thought there have also been widespread declines related to habitat loss.

Program NOCTUA-Portugal – Studying the trend and distribution of owls

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Keywords: citizen science; distribution range; Portugal; trend monitoring

During the last eight years (2009/10 – 2016/17), the Working Group on Nocturnal Birds of SPEA (GTAN-SPEA) has carried out a monitoring program for seven owl species at a national scale (NOCTUA-Portugal) in order to determine their population trends and distribution. The program was a census based on point counts to listen for spontaneous calls. This provided information on owl species range changes over time in Portugal. Over the 8-year period, 75 10x10 km squares were sampled by more than 120 volunteer participants. We tested several methods to assess population trends, including generalized linear models, generalized linear mixed models, generalized additive models and the software TRIM. These different statistical methods produced similar results, although more complex analyses are still limited by sample size. Three species had negative trends - Barn Owl *Tyto alba*, Scops Owl *Otus scops*, and Little Owl *Athene noctua*. The Eagle Owl *Bubo bubo* had a positive trend, whilst the Tawny Owl *Strix aluco* seems stable. Due to the low number of records it was not possible to determine trends for the Long-eared Owl *Asio otus* and Short-eared Owl *Asio flammeus*.

We estimated the species distributions based on the census of the NOCTUA program and non-systematic observations for the period 2005-2017. We defined four periods to study potential changes in distribution of owls in Portugal: 1978-1984 (1st breeding bird atlas); 1999-2005 (2nd breeding bird atlas); 2005-2014 (interval between breeding bird atlases); and 2015-2017 (3rd breeding bird atlas). The distribution of all owl species was stable over this period except that of the Eagle Owl which increased.

The Eurasian eagle owl *Bubo bubo* as biomonitor of contaminants in Southeastern Spain: an overview of 25 years of study

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Keywords:*Bubo bubo*; metals; pesticides; anticoagulant rodenticides; flame retardants

The Eurasian Eagle Owl *Bubo bubo* meets the requirements of a suitable sentinel species for biomonitoring of environmental contaminants in Southeastern Spain. In this area (the region of Murcia and Alicante), it is an abundant species, with approximately 470–530 pairs, showing the highest breeding density and productivity in the entire Palearctic. Since 1992, different sample types from free-living nestlings and adults (blood, feathers, unhatched eggs) or from individuals admitted in the rehabilitation centres (blood, feathers, liver, kidney, brain and bones) were analysed for a wide range of pollutants (metals, organochlorine pesticides, anticoagulant rodenticides, neonicotinoid insecticides), with special attention to analyses of baits and lethal poisoning cases. Also unhatched eggs were analysed for organochlorine pollutants. Specific biomarkers (antioxidant molecules, lipid peroxidation, d-ALAD and blood clinical parameters) were analysed to perform risk assessment. As main findings, the patterns and concentrations of contaminants in Eurasian Eagle Owl samples reflected the contamination influenced by agriculture, an ancient mining area and the use of anticoagulant rodenticides. In general, biomarkers were highly correlated with contaminants (i.e. d-ALAD inhibition by Pb). Overall, we

can confirm the suitability of the Eurasian Eagle Owl to biomonitor contaminants in our study area.

Monitoring owl populations in a natural mountainous forest in the Austrian Alps (Duerrenstein Wilderness Area, IUCN Category I)

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Keywords: Tengmalm's Owl *Aegolius funereus*; Pygmy Owl *Glaucidium passerinum*; primeval forest; breeding density; population dynamics

Between 2015 and 2019 population densities of Tengmalm's Owl *Aegolius funereus*, Pygmy Owl *Glaucidium passerinum*, Tawny Owl *Strix aluco* and Ural Owl *Strix uralensis* have been and will be surveyed. Furthermore, effects of fluctuations in tree seed production and small mammal abundances on the breeding densities are being surveyed. The study area is located between 720 and 1,500 m asl and covers 1,650 ha of mixed stands of Spruce Picea abies, Fir Abies alba and Beech Fagus sylvatica within the Duerrenstein Wilderness Area (IUCN Category I), including the Rothwald primeval forest (400 ha). Each year three standardised surveys are carried out between March and June, using playbacks at 22 monitoring points. Yearly abundances of small mammals as well as seed production of the main tree species are being surveyed by other research groups.

Data from the first three years reveal Tengmalm's and Tawny Owls to be the most common species in the study area. In 2016 a beech mast increased the density of small rodents and in the following breeding season Tengmalm's Owls showed a significant increase in breeding densities from 1.21 to 2.00 territories/100 ha. Breeding success was rather high with at least eleven broods with fledglings confirmed. The species breeds exclusively in natural tree cavities, usually provided

by Black Woodpeckers *Dryocopus martius*. Tawny Owls showed a slight increase from 1.27 to 1.39 territories/100 ha. Breeding success was rather low in 2017, probably due to heavy snowfalls in April. Pygmy Owls showed relatively low densities of 0.30 territories/100 ha; the high

density of Tawny Owls may be the main reason for the scarcity of this species. Ural Owls have been reintroduced to the area and are still rare (0.12 territories/100 ha).

Monitoring of owls in Europe – results of panEuropean EURAPMON inventory of raptor monitoring schemes

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Keywords: owl monitoring; inventory; Europe; EURAPMON; raptor

In 2010 the EURAPMON (Research and monitoring for and with raptors in Europe), Research Networking Programme by European Science Foundation (http://www.eurapmon.net/), was launched, and ended in 2015. The project stressed the importance of raptors, including owls, as top predators to be key species in ecosystems and can be good indicators of the state of wider biodiversity. Raptor monitoring can therefore detect ecosystem change and particular threats, all of which can have significant environmental, social and economic impacts. However, due to specific survey protocols, raptors are often poorly covered by multi-species bird censuses. Raptor monitoring schemes are diverse in nature, rarely centrally coordinated, conducted at different scales, range from academic research to citizen science, and are rarely standardised in approach. Hence there would be great benefit in reinforcing national initiatives, addressing gaps and improving coordination. This applies to monitoring of both the state of raptor populations, and to what raptors can tell us about the environment. During its running the project established a wide network of National Coordinators for raptor monitoring coming from 50 countries. One of the project goals was to inventor raptor monitoring schemes in Europe. 1196 'species-schemes' (236 monitoring programmes; 90% active in 2012) were reported from 37 countries. The inventory considers a wide range of issues, including breeding and migratory populations, breeding success,

environmental parameters, survey and analytical methods (including individual identification techniques) and data applications. Among owls the most monitored species were Tawny *Strix aluco* and Eagle Owl *Bubo bubo*, the highest range coverage was found in two restricted range species in Europe, Snowy *Bubo scandiacus* and Great Grey Owl *Strix nebulosa*. So far not monitored species were Brown Fish *Ketupa zeylonensis* and Pallid Scops Owl *Otus brucei*, and the least monitored with low range coverage were Barn *Tyto alba*, Pigmy *Glaucidium passerinum*, Boreal *Aegolius funereus* and Scops Owl *Otus scops*. This talk will present results, summarise the state of play and highlight future challenges.

Migration and dispersal

TytoTagus: Barn Owl post-fledging dispersal in the Tagus Valley (Portugal)

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Keywords: Barn Owl; dispersal; Tagus Estuary; Portugal; telemetry;

The Tagus Estuary lowland farmland receives a notable concentration of Barn Owls during the post-fledging dispersal period, with an abundance of more than 15 owls/km along some dirt roads in an area known as Ponta da Erva. The TytoTagus project aimed at (1) determining the origin of the barn owls found in the Tagus Estuary by visual colour ring recaptures via car transects and (2) determining juvenile owl dispersal patterns in the Tagus Valley by radio-tracking. From 165 Barn Owls ringed as nestlings in 2007-2012, 6.2% were visually recaptured from two areas near the estuary: 14 from Benavente – Vila Franca (<15 km) and two from Coruche (45-60 km). In order to understand the factors which may be relevant to Barn Owls dispersing towards the estuary, 41 juveniles were tagged with VHF transmitters (29 in Benavente – Vila Franca and 12 in Coruche). During emancipation contact was lost with 16 owls and 13 were found dead. One tag failed when the owl was still in the nest and 12 owls were tracked during dispersal. Dispersal consisted of a succession of temporary roosts, alternating dispersal movements with stop phases in which individuals remained in an area and used one single or several nearby roosts. Distance to the nest clearly corresponded to approximation to the estuary in six owls. In the other cases, owls remained in Coruche or came from nearby nests and were roosting in a northern area of the estuary (despite increased distance to Ponta da Erva, south floodplain). Although the distance between roosts and hunting areas was generally < 3 km, juveniles hunting in the estuary may have roosts at least 10 km away. Juvenile Barn Owls mainly used trees as roosting sites (e.g. trees along roadsides and riparian galleries) and forest patches

contiguous to open agricultural areas (mixed stands of cork oak and pine, montados and pine forests).

Juvenile Barn Owl *Tyto alba alba* Dispersal: A Radio Tracking Study

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Keywords: Barn Owl; Juvenile Dispersal; Radio Tracking

United Kingdom Barn Owl *Tyto alba alba* population size is mainly determined by juvenile mortality and most occurs during dispersal. This, combined with the species decline, prompted Ambios (ambios.net), Biotrack (biotrack.co.uk) and the Barn Owl Trust to team-up to find out more about roost site selection and dispersal in relation to landscape topography. Also, to test published statements that young Barn Owls use 'dispersal corridors', avoid 'hilly areas', and that major roads act as 'partial barriers' to dispersal.

We radio tagged 19 fledglings over a four-year period in southwest England of which 12 were successfully tracked through dispersal. We located daytime roost sites and examined movements in relation to landscape topography and the distribution of large rivers and major roads. Temporal variation between the marked birds, distances moved, types of roost site used, and other variables were recorded.

Dispersal appeared largely random. Some young birds left their natal site earlier than expected (62 days) and others later than expected (109 days). Within broods, the eldest was quite often the last to disperse, females generally travelled further than males, and siblings sometimes roosted in the same place, or very close together, up to 5.5 km from their natal site. Despite originating in nest boxes, mainly in buildings, all birds roosted in trees and some birds only roosted in trees.

According to observations made in this study, Barn Owls do not disperse along large rivers or major roads ('dispersal corridors' do not exist) and they do not avoid hilly areas. Evidently, they are able to cross major roads repeatedly before becoming a casualty or dispersing further afield. Observed behaviour did not differ from that described in a similar study.

Migratory behavior and breeding dispersal of Burrowing Owls in the western United States

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Keywords: Burrowing Owls; migration; geolocator; satellite transmitter; wintering; Mexico

Burrowing owls *Athene cunicularia* have declined throughout their range, and identifying the potential cause(s) of those declines requires better knowledge of migratory routes, wintering locations, and breeding dispersal. To provide this information, we deployed geolocators on 296 owls and solar-powered satellite transmitters (PTTs) on 34 owls at locations throughout the U.S. Eighteen percent of the geolocators and 53% of the PTTs produced useful data on migration behavior. All owls that bred in Oregon and Washington wintered in the U.S. and migratory behavior differed between males and females: females wintered in California whereas most males wintered in Washington. In contrast, most burrowing owls from interior states migrated to Mexico for the winter. Distance between breeding and wintering sites varied from 983-3250 km. Owls had stronger site fidelity to their wintering locations than to their breeding sites (P=0.05): the average breeding dispersal was 34.7 km (range 0-164km) whereas the average distance between consecutive wintering locations was only 0.1 km (range 0-0.8km). We documented substantial variation among individual owls in the time spent migrating but no difference between time spent during spring and fall migration: 6-57 days on fall southbound migration (mean 22.9 days) and 6-51 days on spring northbound migration (mean 21.6 days). Over 90% of the owls that we tagged in Colorado, Montana, South Dakota, and Nebraska, took a multi-day break from migration in an area of nw Texas. The median date that females began their fall (southbound) migration was 9 Oct (range 17 Sep – 27 Oct), and the median arrival date that females arrived at their nesting location in the spring was 7 Apr (range 21 Mar – 5 May). Our results identify important stop-over and wintering locations that may be important for continent-wide burrowing owl conservation.

Discovery of fall migration of Northern Saw-whet Owls *Aegolius acadicus* in the Ozarks of Missouri, Arkansas, and Oklahoma (USA)

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Keywords: fall migration; Ozarks (USA); Northern Saw-whet Owl

Northern Saw-whet Owls *Aegolius acadicus* breed in forests of northern North America, the western Rocky Mountains, and parts of the eastern Appalachian Mountains. Though widely captured during fall migration in eastern North America, the full extent of the autumn dispersal and winter distribution is poorly known. Saw-whets are notoriously silent and secretive during the non-breeding season, making them difficult to locate. Since 2010, efforts to capture saw-whets during fall migration have been underway in the south-central United States, where the species was previously considered rare with sporadic historic fall/winter records in Arkansas and Oklahoma. Nocturnal banding efforts with audio lures began in 2010 in central Missouri (Missouri River Bird Observatory), in 2012 near St. Louis, Missouri (World Bird Sanctuary), in 2014 in northwestern Arkansas (Pruitt and Smith) and in 2016 in northeastern Oklahoma (Revels and Ramirez) and central Louisiana (Marshall). Banding efforts continue to be successful, with a total of 326 saw-whets captured in Missouri, Oklahoma, and Arkansas since 2010. No owls were captured in Louisiana to the south. Throughout the Ozark region, the most frequently captured age class was hatch-year (HY), 45.9% of total captures. Second-year (SY) owls were encountered 23.7% of the time, followed by after second-year (ASY) at 20.3%. Other age classes made up less than 11% of captures. The sex ratio was 75.1% female, 9.9% male, and 15.1% unknown (majority of unknown individuals were HY, where the most overlap is possible). Second-year females were most commonly encountered, followed by ASY females, HY females, and HY males. The majority

of males were HY, likely due to sex-differential migration strategies in adult saw-whets, with females wintering further south than adult males. Based on 12 foreign recoveries and recoveries of 4 Missouri birds, owls appear to be coming from the western Great Lakes, a heretofore unknown migratory route.

Movement behaviour and habitat

Home range, perch heights and reactions to approaching humans by three radio-tagged Ural Owls

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Keywords: Ural Owl, flight initiation distance, home range, perch height, telemetry

Three radio-tagged Ural Owls *Strix uralensis* (one pair and one female with nests 8.3 km apart) were tracked from 20 May to 26 December 1989 in Hedmark county, south-eastern Norway. Their positions were determined by cross-triangulations, or by direct observations when approaching them, with a portable receiver and yagi antenna. The mated male and female were located 67 and 22 times on 29 and 17 separate days, respectively, while the other female was located 18 times on 15 separate days, in total 107 locations were plotted. From September on, the male moved out of his previous range and eastwards into Sweden. Home ranges were thus treated as summer ranges until this date, and winter ranges thereafter. Calculated by convex polygon method, the summer (May - August) home range was 11.5 and 7.0 km^2 for the mated male and female, respectively, and 21.8 km^2 for the other female, while the corresponding winter (September – December) home ranges were 61.0, 20.5 and 36.9 km^2, respectively. Overall home range for the whole tracking period was 109.8 and 50.5 km^2 for the mated male and female, and 39.4 km^2 for the other female. When the owls were observed before being flushed, perch height ranged 2.5-8 m, with an average of 5.1 m. When being flushed, flight initiation distance was on average 21 m (range 8-35 m), and not related to perch height. In 9 cases the owl was circled without being flushed, with shortest distance ranging 8-45 m, on average 19 m. When the owls took off before being spotted (11 cases), the distance estimated by cross triangulation ranged from 25-125 m, with a mean of 67 m. In 6 cases they were circled at estimated distances ranging 30-100 m and a mean of 59 m without being spotted or flushed.

Long-term telemetry study of reintroduced Ural Owls *Strix uralensis* in the Duerrenstein Wilderness Area, Austria

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Keywords: Ural Owl, reintroduction, Austria, telemetry, *Strix uralensis*

In the first half of the 20th century the Ural Owl *Strix uralensis* became extinct in Austria. From 2008, the Research Institute of Wildlife Ecology (FIWI) and the Duerrenstein Wilderness Area Administration began a project to reintroduce the owl to Austria's woodlands. In the Duerrenstein Wilderness Area, long-term telemetry is used to monitor success, improve reintroduction strategies and to expand the nest box network in the region. Telemetry is also used to learn about the Ural Owl's biology including habitat selection, foraging preferences, breeding success and dependence on beech and small mammal cycles. Between 2009 and 2017, 140 young Ural Owls were released in the Duerrenstein Wilderness Area as part of the project. A total of 110 transmitters of five models using three telemetry systems were used: two terrestrial telemetry models (n_{type1}= 18, n_{type2}= 46), one satellite telemetry model ($n_{sat.}$= 3) and two GPS-GSM-telemetry models (n_{solar}= 5, $n_{battery}$= 38). In the first nine years of the project more than 13,000 owl positions were registered by means of telemetry (n_{type1}= 1,351, n_{type2}= 6,182, $n_{sat.}$= 243, n_{solar}= 301, $n_{battery}$= 5,033; n = 13,110; date: 3rd June 2017). The GPS-GSM-telemetry has replaced the other telemetry systems because of comparatively low costs, high accuracy, automatic storage of GPS-data and transfer via the GSM net. By using telemetry the ideal age for the release was determined; movement routes of over 100 km, survival rates of about 75% in the first year after release, and various causes of death (e.g., predation by Golden Eagle, endoparasites, cachexia, etc.) were recorded. Telemetry will continue to be used in the reintroduction project to guarantee success and to collect more valuable data for this and other reintroduction projects.

Home-range and habitat of the Barking Owl *Ninox connivens* in Southern Australia

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Keywords: home range; habitat use; conservation; forests; woodlands; Australia

The Barking Owl *Ninox connivens* is threatened in all of the southern Australian States in which it occurs (NSW, Vic, SA, WA), despite being common in northern Australia. Extensive field surveys have shown that it is either very uncommon or absent from the tall, wetter forests of the east coast and adjacent ranges and occurs mainly in drier forests and woodlands on more fertile soils that have been extensively cleared for agriculture. The stronghold for this species in southern Australia now appears to be the extensive Pilliga forests (~500,000 ha), on the north-western slopes and plains of NSW. We trapped and radio-tracked nine birds from eight territories to obtain basic information about home-ranges, movements and habitat use in the Pilliga forests. We also trapped and colour-banded 36 birds from 22 territories to estimate population density in this environment. We found that Barking Owl home-ranges (MCP) averaged 1908 ha (range 1431-2643 ha), although they focused much of their activity within smaller areas (FK95%: average 524 ha, range 203-745 ha). Population density was at least 20 pairs within our 50,000 ha study area, although this information was gathered over several years and we could not be sure that all territories were occupied simultaneously. Barking Owls foraged in all of the available forest vegetation types (mixed Eucalyptus-Callitris forests) but displayed preferences for nest tree species (*Eucalyptus blakelyi, E. camaldulensis, E. crebra* and dead trees) and roost tree species (*E. crebra, Callitris glaucophylla, Casuarina cristata, Angophora floribunda* and *Geijera parviflora*). Barking Owls were previously thought to be associated with forest edges and fragmented woodlands, but we believe this is an artefact of clearing for agricultural development, and the birds remain vulnerable in these environments. In the Pilliga forests,

Barking Owls maintain high population densities within the forest and woodland interior although they often foraged near forest tracks and other forest openings.

Barn Owl *Tyto alba* habitat selection and foraging strategies

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Keywords: barn owl; home range; habitat selection; GPS; conservation

One of the main reasons for the recent dramatic loss of biodiversity is agricultural intensification which has led to a global landscape modification and homogenisation. As a synanthropic species that lives mainly in agricultural areas, the barn owl *Tyto alba* is one of the most widespread raptors in the world. However, recent studies have highlighted its vulnerability to intensive agricultural practices, witnessed by the decline of the population in Europe over the past decades. For effective conservation and population management, it is crucial to understand the effect of habitat composition and hunting ground quality on barn owl reproduction. In our study, we monitored 36 barn owl broods from hatching to fledging and equipped the parents with GPS tags, in parallel with high resolution habitat mapping. We estimated home range composition and assessed foraging habitat selection. Our results showed a strong preference for extensively exploited areas such as wild flowers, grasslands and pastures. Furthermore, we emphasized that higher proportions of preferred habitat within a home range have a positive influence on nestling development. Finally, we highlighted differences in prey provisioning, time budget and hunting techniques between individuals and sexes. In conclusion, our study highlights first, the importance of extensively exploited habitats for the barn owl during the breeding season and second, strong differences in hunting effort and time allocation between the sexes. These first results obtained for a Swiss barn owl population raises broader questions, at the scale of Europe.

Short-eared Owls *Asio flammeus*: sensitivities to changes of land use in upland Britain

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Keywords: conservation; monitoring; moorland; forestry; predation;

Although widespread, populations of Short-eared Owls are declining in most parts of their range. For example, their breeding range in Britain contracted from occupancy of 381 ten-km squares with high levels of evidence of breeding in 1990 to 245 by 2010. Within Scotland, which has a high proportion of preferred upland habitats, range contraction measured by absolute square occupancy was the second greatest of any bird species. Potential environmental determinants of distribution and change were identified by review of the species' known ecology including literature and ongoing telemetry studies of habitat use. Generalised Additive Models were then used to assess associations of environmental variables with the recent distribution and change over the preceding two decades. Variables identified for inclusion in the models were: semi-natural habitats, temperature, rainfall, elevation, slope, woodland cover, young growth stage forests, measures of predator occurrence and their control, vole occurrence. Limitations for breeding Short-eared Owls included the distribution of their favoured prey, voles. Threats to their current status included forest expansion, the introduction of predators onto islands and changes in moorland management that could result in increased numbers of predators. Opportunities for restoring breeding populations included increasing areas where densities of ground predators are maintained at low levels and adapting forest management plans to include open habitat specialists. Further work is required to: (i) improve monitoring to better understand the nature and distribution of change; (ii) refine the predictive models to include variables that could act as proxies for vole availability; (iii) better understanding of the role of habitat interactions at their interface (e.g. forest and moorland); (iv) better understand the role of intra-guild relationships among predators that may affect short-eared owls; (v) and improved knowledge of their migrations and winter (year-round) habitat requirements.

Movements and habitat selection of Short-eared Owls *Asio flammeus* in North America

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Keywords: *Asio flammeus*; banding; satellite telemetry; habitat use; irruptions

Effective conservation and management of Short-eared Owls *Asio flammeus* requires an understanding of population size, distribution, and linkages, as well as habitat requirements. Research in North America over the past decade has advanced knowledge of these subjects, though many gaps remain. Until recently, data on Short-eared Owl movements were largely limited to banding recoveries, with only 54 records since 1923, mostly short- or medium-distance recoveries (mean 191 km; maximum 1,244 km). Satellite telemetry of 26 Short-eared Owls from Alaska revealed long-distance fall migration (ranging from 3,205 to 6,886 km) to a broadly dispersed wintering range, and low site fidelity in owls that returned northward in spring. While Short-eared Owls are generally considered to use a broad range of open habitat types from tundra to grassland to wetland, very little of this habitat in North America is occupied at any given time, suggesting that more specific preferences exist. A study of wintering Short-eared Owls in New York revealed that ground roosts were associated with significantly greater thatch depth, grass cover, maximum grass and forb height, number of vertical strata, and vegetation diversity; foraging occurred preferentially in fields with an abundance of vole runways and high forb cover. Similarly, research in Ontario found Short-eared Owls nesting in loose aggregations in areas with taller grasses. Larger concentrations of dozens to hundreds of Short-eared Owls are occasionally reported at various locations across North America. Multiple such occurrences have been recorded at Beaverhill Lake in central Alberta, where maximum abundance correlates with vole abundance, in turn triggered by a peak crop of plants such as alfalfa and foxtail barley.

Expanded documentation of irruptions and satellite tracking of individuals at such locations is considered a research priority.

Habitat selection and movement patterns of wintering male and female Snowy Owls on the Canadian prairies

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Keywords: Snowy Owl; competition; prey availability; satellite transmitters; habitat

Birds overwintering at high latitudes may find it challenging to meet their energy budgets when thermoregulatory costs are high and food availability is low. Snowy Owls *Bubo scandiacus*, like most owls, exhibit reversed sexual size dimorphism, so if high quality (food-rich) habitats are limited, we predicted that the larger and dominant females would use better quality habitat and have smaller home ranges than males. In Saskatchewan where many Snowy Owls overwinter annually, we measured prey (small mammal) abundance in fields with four types of cover, and related this estimate of habitat quality to its use by the sexes. Small mammal abundance varied annually but not among three types of crop cover; however, prey was less abundant in pastures than in croplands in one of three years. Bi-weekly surveys of owls conducted during two winters along a 60 km transect revealed a weak selection for legume fields, especially for males. The home ranges of females fitted with GPS/GSM transmitters contained proportionally less canola stubble than those of males. Within home ranges, males avoided canola stubble, and tended to use legume fields more, whereas females used habitats in proportion to availability. Owls may avoid canola stubble because the rigid stalks impair hunting compared to the easier accessibility offered by stubble-free legume fields. Fewer Snowy Owls than expected by random were seen at locations along the transect within 800 m of Great Horned Owls *Bubo virginianus* and their associated habitats suggesting that Snowy Owls also avoided these potential competitors on the landscape. The frequency with which owls stayed on home ranges versus moved on the landscape did not differ between the sexes.

Ecology

The irruptive nature of Snowy Owls: Going full cycle

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Keywords: behavioral ecology; breeding dispersal; irruptive movements; snowy owl

Many owl species are known to behave as irruptive species, i.e. showing huge and periodical fluctuations in number in a given area. The Snowy Owl *Bubo scandiacus* is a classic example of such a species but until recently, the limited empirical evidence did not allow a thorough description of its behavioral ecology over a complete life cycle. We have studied snowy owls for more than 20 years in North America using nest monitoring, diet analyses and individual tracking to connect the breeding and wintering grounds. At our long-term study site of Bylot Island, Nunavut (Canada), nesting density of snowy owls varies annually, mirroring the high-amplitude variations in abundance of its main prey (lemmings). Indeed, during the breeding season, snowy owls have a highly specialized diet almost entirely made of lemmings. At the site, both snowy owl and their prey usually exhibit peaks in abundance every 4 years and the average clutch size (n=7.1) is relatively high for an owl species. Tracking individuals revealed that adults displayed some of the greatest breeding dispersal distances ever measured annually in a bird species (up to 2224 km) and that most of them breed every year, in areas where lemmings are abundant. Individual fidelity to a breeding area is thus very low. During winter, most adults remain at high latitudes and individuals tend to be more faithful to their wintering areas than for breeding. Periodic winter irruptions south of the boreal forest occurring roughly every 4 years are mainly composed of juvenile individuals and their body condition is usually good. Even if some aspects of the behavioral ecology of the snowy owl still remain to be assessed (breeding pair fidelity,

dispersal behavior of juveniles and precise origin of winter irruptive individuals), those results provide empirical details of its irruptive nature.

How does diet influence breeding success of the Tawny Owl *Strix aluco* in the forests of Burgundy?

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Keywords: Tawny Owl; Burgundy; France;diet, breeding success

The Tawny Owl *Strix aluco* has been studied in different forests of Burgundy, France since 1980. Almost 8,000 birds have been ringed. Demographic results have been obtained regarding mate and nest fidelity, longevity, natal and breeding dispersal, diet, and breeding success. This presentation deals with the relationship between the two latter aspects. The diet has been described from the analysis of pellets from young and adult owls, as well as from prey and the feathers found near the young. Breeding success was defined as broods having at least one young. The Tawny Owl depends very much on small forest mammals, especially *Apodemus sylvestris, A. flavicollis and Myodes glareolus.* Whatever the type of forest and whatever the year, the higher the percentage of these three species in the Tawny Owl's diet resulted in greater breeding success.

How Tawny Owls *Strix aluco* survived in a dynamic guild of predators and turned from a source into a sink population

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Keywords: Tawny Owl; Netherlands; long-term study; predators; competitors; population dynamics

A long-term study of owls and birds of prey was conducted in the Netherlands from 1957-2017. During this period 4 new species of birds of prey and two species of mammalian predators colonized the study area; an additional 4 species of owls and birds of prey were already present from the beginning. The arrival of the bigger predators had a big impact on the composition of the population. Several of the smaller species did not survive these revolutions. In this study we report how Tawny Owls survived the colonization of the area by new predators. Several times they were forced to share food resources with the new predator guild members. While the Tawny Owls many years were the top predator in the study area for many years, they became exposed to predation and had to compete not only for food but also for nesting places. The recruitment of young Tawny Owls into the population diminished and the continuation of the breading population became dependent on immigration of birds born outside the study area. Collectively, these circumstances lead to the conclusion that the population has changed from a source to a sink population.

Birds as food of owls – an intra- and inter-specific comparison

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It is well known, that owls predate other birds. But despite a huge amount of literature, syntheses on owl's diet are available for few owl species only. Therefore quantitative comparisons of birds as food of different owl species are missing. The same is true for comparisons of prey of several species in different regions or seasons. Further methodical problems exist for such comparisons as means or ranges are not very informative to describe skewed distributions. I built a data frame with data assembled from literature. It contains more than 3700 quantitative prey lists on eleven owl species with more than 40 prey lists. I will present a graphical tool to compare high numbers of prey lists. In the eleven owl species, 3.1 to 20.4 % of all prey lists did not contain any birds. Median proportion of birds in prey lists varies between 1.4 % in *Tyto alba* and 15.7 % in *Bubo bubo.* This data suggest, that owls often eat some birds but in low numbers. But in most owl species, there are some prey lists with high proportion of birds. In *Bubo bubo* 10 % of all prey lists contain more than 45 % birds. The results are very similar considering biomass instead of prey items, but the proportion of birds is slightly higher. Intra-specific differences are also important. e.g. birds are rare as *Asio otus* prey in North America, whereas they are common in south Europe, Asia and northern Africa. The pattern, that the proportion of birds is higher in Europe than in North America is common in several species or related species (*Tyto* spec., *Bubo* spec., *Asioflammeus*) but *Athene cunicularia* preys more upon birds than the related *Athene noctua*.

Modeling voles' spatial distribution through Barn Owl diet analysis: Setting the scene for a pest-control nest box scheme in Thessally, Greece

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Keywords: Barn Owl, voles, spatial distribution, nest-box, Greece

Thessaly is the largest agroecosystem in Greece, and thus one of the most important breeding areas for the Barn Owl. A total of 30.000 Barn Owl prey items, systematically collected and identified for a three year period, revealed an assemblage of 15 different small mammal species in the region varying in space and time. Four species of voles are present, including Harting's vole *Microtus hartingi*, a major pest with cyclic outbreaks. Barn Owl breeding sites decline in the region since 2005, and at the same time vole outbreaks have created thorough losses to manifested crops. The goals of the study are: 1) explore vole distribution patterns in Thessaly and define areas mostly affected by pest voles, 2) define which environmental parameters drive these spatial patterns, 3) select optimum sites for a Barn Owl nest-box scheme.

In order to explore voles' spatial patterns through Barn Owl diet spectrum, the species' relative frequency of appearance was modeled through GIS for a total of 31 Barn Owl breeding locations, along with a set of environmental parameters calculated within a 2km buffer around each site. General Additive Models were used as well in order to explore environmental gradients that define vole distribution and abundance.

All vole species demonstrated strongly different patterns in Thessaly. Crop types played a minor role in affecting vole presence, except pastures, whereas arable and non-arable land uses played major role as significant gradients for Harting's Vole and East European Vole *Microtus levis*. The rare and low-abundant Gray Dwarf Hamster *Cricetulus migratorius* mostly reacted to irrigation

intensity, whereas Thomas's Pine Vole *Microtus thomasi* showed preference for small granulometry "heavy" soils.

Harting's vole distribution and vole outbreaks mainly concentrated in southeastern Thessaly, where 50 initial nest boxes are placed. First year data show more than 25% Barn Owl occupation rate and an average of 2.9 fledging success 96% CI [0.507 , 1.347]. Once initial data are thoroughly evaluated 50 more nest boxes will be raised. The Barn Owl nest box scheme is expected to function both as a conservation action as well as the initiation of a long-term natural pest-control project.

Age and sex of Snowy Owls during summer irruption on Beliy Island, Yamal in 2015

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Keywords: Snowy Owl, irruption, sex and age distribution, photo identification

In early summer 2015 a superpeak of lemmings appeared on Beliy Island north of Yamal Peninsula, Russia. Considerable numbers of Snowy Owls *Bubo scandiacus* turned up as a result of the abundance of lemmings. During four days from 7 to 15 July, 69.7 km was covered on foot. Snowy owls were approached and photographed, and a total of 344 images were secured of both sitting and flying birds. At most 89 individual Snowy Owls were seen from one vantage point. Images were sorted by number and time recorded on the image files for the dates 7, 9, 13, and 15 July. Images which could be used to sex and age the owls, were treated in Photoshop to enhance details of molt and bar patterns in wings. The birds were aged analyzing molt patterns described by Solheim (2012) and later collected molt data (Solheimunpubl.), and individuals were recognized by bar and molt patterns in their wings (Solheim 2016). A total of 25 different individuals (11 males and 14 females) were aged, of which 14 (56%) were second calendar year birds hatched in 2014. Six owls were in their second or third wing feather molt, thus classified as 3CY-4CY birds, while only five were birds with no juvenile flight feathers left (5CY+). Several individuals photographed sitting on the ground only, appeared to be juvenile 2CY birds too, but were not included in these numbers. Although two nesting pairs were recorded, the majority of the Snowy Owls on Beliy Island in July 2015 were thus young, presumably non-breeding birds. This study shows that photographying as many Snowy Owls as possible during an irruption may reveal the age and sex distribution of the birds present.

POSTER PRESENTATIONS

1. Migration of Eurasian Scops Owl *Otus scops* over north of the Sahara fringe and Southwestern Mediterranean

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Keywords: Eurasian scops-owl, migration, southern Europe, southern Morocco, stopover ecology

The European scops-owl *Otus scops* is the only European Owl that undertakes a long migration south of the Sahara desert. The breeding ecology of the species at southern and eastern Europe is known but the migration ecology and in winter territories located in the Afrotropical region are poorly known. Here we present data on the passage of European Scops owl at north of Sahara fringe and southern Mediterranean during spring migration. From the Project Piccole Islands (PPI) we show data about the migration of the species over the Iberian Peninsula and small islands in the western Mediterranean between 1993 and 2011. A total of 530 individual owls were captured and marked during this period. Moreover, another project, similar to PPI, started at the north fringe of the Sahara on an oasis located at southern Morocco, and was operated from 2009 to 2013. During these five years a total of 23 individual owls were captured and marked. Data about the phenology and biometry of the captured individuals and inter-annual comparisons are shown.

2. Distribution and current state of the short-eared owl *Asio flammeus* in Ukraine

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Keywords: Short-eared Owl; Ukraine; habitat loss; population decline

Until the beginning of the XXth century, the Short-eared Owl was a common breeding species in the current territory of Ukraine (Dzieduszycki 1880, Somov 1897, Valh 1900, Averin 1910). Today it is quite rare in Ukraine, breeding in small numbers in some areas (eg. Polissia). The species was investigated rather poorly and sporadic in Ukraine. The breeding density of this species was 0.03 pairs/ 100 ha in Eastern Polissia, (Kuzmenko et al. 2013). In Western Polissia (Shatskyi NPP), a decrease of breeding pairs was noted from 1.02-1.23 (1982-87) till 0.41-0.82 pairs/100 km² (1997-2001; Gorban 2002). In the wet meadows of the upper part of Dniester river basin (western Ukraine) the breeding density was 1.1 pairs/100 km². In some places, it reached up to 1.0 pair/100 ha. In the steppe zone (southern and eastern Ukraine) the number was estimated from 0.1 (valley of Samara river; Bulakhov et al. 1999) to 0.58-1.93 pairs/100 ha ("Striltsivskyi step" Nature Reserve; Moroz 2011). Today it is estimated at 700-1400 breeding pairs in Ukraine. In some areas (the Black Sea coast, the Crimea) the Short-eared Owl was observed mainly during migration and winter periods. It was quite numerous during some warm and relatively snowfree winters in the northern part of the country. In the steppe regions, the winter density fluctuated between 0.97 and 7.50 individuals/100 ha (Sirenko & Martynov 1998). In some years, mass wintering has been noted reaching about 100-170 individuals/100 km² (Upper Dniester lowland). A significant decline of the Short-eared Owl population was noted since the 1960s in Ukraine caused by degradation of meadow habitats by livestock grazing, burning of vegetation and shooting. Drainage changed the hydrological regime and caused a negative effect on breeding habitats. The species did not recolonize some areas, despite the re-naturalization of wetlands.

3. Biogeographic analysis of Eurasian Eagle Owl's *Bubo bubo* diet across the Palearctic Region

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Keywords: *Bubo bubo*; Diet diversity; Eurasian Eagle owl; Palearctic region; Prey specialization

Studies about top predator's diet are common at a local scale, but not at a large spatial scale. However, the study of a species' diet across different geographic regions may allow the detection of certain patterns and variations which might influence its ecological features. Birds in general are exceptional study models because both their distribution and diet are well known. While the Eurasian Eagle Owl *Bubo bubo*, a top predator, is usually a diet generalist it can also become specialized on certain prey species when those prey are abundant. We created a database of the Eurasian Eagle Owl's diet based on a review of 193 papers reporting on the diet of nine Eagle Owl subspecies across its Palearctic distribution. We analysed large scale biogeographic diet variation to understand how the species adapts to different environmental conditions, including climate, landscape and prey availability. A total of 346,811 prey items belonging to 698 different species were recorded from the literature in addition to some undetermined prey reported only to genera and families. The percentage of mammals was much greater than that of bird. Rodents, lagomorphs, galliformes, and corvids comprised the greatest percentage of recorded prey items. There was a positive trend of percent mammals in the diet and a negative trend of percent birds in the diet with increasing latitude. More rodents but fewer lagomorphs and insectivores were in the diet with higher latitude and longitude. There was also a non-significant trend for more galliformes in the diet with increasing longitude. In addition, more mammals were in the diet with higher annual mean temperature. Finally, the results showed that more birds and fewer mammals were in the diet in areas with higher precipitation volumes.

4. The status and conservation of owls in China

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Keywords: Status, Distribution, Conservation, Owls, China

There are 33 species of owls in China, belonging to 12 genera in 2 families (Tytonidae and Strigidae). As an important group of birds at the top of the food chain, owls play an key role in the protection of biodiversity and maintaining ecological balance. However, basic research on owls has been limited to only nine or 27.3% of China's owl species. These include *Ninox scutulata*, *Otus elegans*, *Asio otus*, *Athene noctua*, *Otus lettia*, *Aegolius funereus*, *Strix uralensis, Strix newarensis* and *Phodilus badius*. Other owl species in China lack information on basic distribution, such as the Dusky Eagle Owl *Bubo coromandus* for which there are only two records in Jiangxi and Fujian several decades ago.

All owls in China have been listed as National Grade II Key Protected Animals. The Blakiston's Fish Owl *Bubo blakistoni* is endangered and the endemic Sichuan Wood Owl *Strix davidi* is vulnerable according to the "China Species Red List". However, the state of owl conservation in China is not optimistic. Possibly because of their ugly appearance and harsh sounds, owls have long been regarded as unlucky birds by ancient Chinese people. Poaching is still a serious threat to owls in China, and there have been many reports of illegal transport of owls to south China for human consumption. In April 2017, 229 owls were found being transported in a bus, and most of them were nestlings of the Eurasian Eagle Owl *Bubo bubo*. We believe that China should do more to promote, protect and conduct more basic research on owls, especially those endemic and endangered species.

5. Designs for nest box, owl stopper, and patio trap for *Otus scops* research

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Keywords: *Otus scops*; nest box; owl trap design and construction; research methods

In 2017, we began conducting migration and demographic work on the Scops Owl *Otus scops* in Turkey. This methods paper is focused on three practical aspects of conducting Scops Owl research using nest boxes and related equipment. Based on the literature and input from other researchers, we developed and built nest boxes, a device (owl stopper) to capture owls by keeping them from exiting the nest boxes upon our approach, and a patio trap for capturing male owls. We offer specific plans with dimensions, material lists, and construction instructions and techniques to enable researchers to build and use these items for research on these small forest owls.

6. Does moonlight really stimulate the vocal activity of Eagle Owls?

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Keywords: *Bubo bubo*, Eagle Owl, moonlight, vocal display

Frequent auditory surveys were performed during the principal fall and winter calling periods within an monitoring project studying a population of Eurasian Eagle Owls *Bubo bubo* near Freiburg (Baden-Württemberg, southwest Germany). The surveys focused on the owl's primary vocalization around sunset; playbacks were not employed the ensure natural vocal display. Using data from surveys conducted 2014–2016 we attempted to establish how the vocal display activity may be affected by moonlight. In combination with differential sky cover (clear vs. covered), vocal activities during full and new moon phases were compared. No positive effect of intense moonlight under clear sky conditions (full moon vs. new moon) on the frequency of calling by resident males was detectable in the study. The onset of calling time (time of first call), the length of crepuscular vocalization and the number of calls per individuals were likewise unaffected by the moon phase. Thus, the results of this study do not support the view that the increased visibility and signaling strength of the white throat badge under full moon illumination stimulate and increased vocal activity of male Eagle Owls. No such effect could be demonstrated for the main dusk vocalization period of Eagle Owls in our population. The calling activity in our region was generally lower compared to other Eagle Owl populations in Germany and some Mediterranean regions. Individual males showed significant differences in their vocalization behavior. It appears that the low density of our population (<2 resident pairs per 100 sq. km; mean distance to nearest neighbor: 7.8 km; minimal distance 1.4 km) may imply reduced territorial conflicts and competition, thus reducing the need for extensive vocal display activity of the resident males in their territories.

7. Status and distribution trends of Little Owl *Athene noctua* in Bulgaria

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Keywords: Little Owl; *Athene noctua*; Status; Trends; Bulgaria

Little Owl *Athene noctua* is one of the best known owls in Europe. If preferably inhabits settlements with small open areas and nature friendly agricultural activity giving enough prey and breeding cavities. This species has declined in many parts of Europe. To observe its distribution trends in Bulgaria, we analyzed a 10-year data set (2007–2016) obtained by stimulation of its territorial call.

More than 95% of Little Owls in Bulgaria occur in settlements – towns and villages. Most of them prefer to breed below 500 meters above sea level. For all observed localities a decreasing tendency has been found.

A special relationship between humans and Little Owls exists. The species needs cavities in buildings for nesting and nature friendly agricultural practices are important for prey availability. Despite their dependence on human presence it is necessary for the owls no to be disturbed. Changes in natural and anthropogenic ecosystems are the principal reasons most of the common bird species in Bulgaria are in decline. The major threats for Little Owl are abandonment of buildings, especially in the small villages (no food), rebuilding of roofs without entrance holes (no places for breeding), herbicides and pesticides usage.

8. Monitoring, ringing and demographic parameters of two Eurasian Eagle Owl populations in the Iberian Southeast

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Keywords: occupancy, reproductive parameters, ring-recoveries, mortality, Spain,

This study was focused on monitoring, ringing, breeding, and causes of mortality in two Eurasian Eagle Owl *Bubo bubo* populations in the southeastern Iberian Peninsula, Spain. This area is a quaternary sedimentary basin surrounded by two mountainous systems, separated per less than 50 km. The northern zone was a high-density population area with >40 pairs/100 km^2. The southern zone held a medium-density population with aprox. 20 pairs/ 100 km^2. During 11 years (2006-2016), 126 territories were monitored in these zones, where 1374 nestling and 55 adults were ringed during the breeding seasons. The average annual territorial occupancy rate was 0.80, the average annual breeding success was 0.81 and the average annual productivity was 2.10. During the study period we recorded 131 Eagle Owl ring recoveries – a 9.1 % recovery rate. The results of this ringing data show that 44.7% of the individuals found were <1 year old, that 30.9% were of 2 yr-old individuals, that 16.3% were 3 yr-old individuals, and just 8.1% were individuals > 3 yrs. The main causes of mortality (n=115) were: powerline interaction (46.9%), starvation (20.8%), road-kills (7.9%), and other causes (7.9 %). The cause of mortality could not be determined in 16.5% of cases, due to the high degree of carcass decomposition. An additional 7 owls were recaptured as breeding adults (5.7% of the recoveries). Overall, we did not find significant differences among the reproductive parameters in the two zones (high territorial occupancy rate and high breeding success), except in the productivity (2.08 northern zone vs 1.82 southern zone; P = 0.0127). Moreover, we detected a high mortality by electrocution and relatively low dispersal distances in both populations.

9. The Eagle Owl *Bubo bubo* as a breeder on buildings

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Keywords: Eagle Owl, Pharaoh Eagle Owl, Great Horned Owl, building breeder

In Germany, Eagle Owls have been known to breed on man-made structures since the middle of the 16th century. Frequent use was made of such sites, mainly ruins, castles and churches, until the middle of the 19th century and the last documented cases for that century occurred in the 1880s. There was one isolated record in 1927. In the case of the Pharaoh Eagle Owl *Bubo ascalaphus*, breeding has been documented on the pyramids and other ruins in Egypt from 1897 until today. Nests of the Great Horned Owl *Bubo virginianus* have been found in Indian ruins, barns and various modern structures since 1909. In Germany, more 150 different man-made structures have been used by the Eagle Owl as breeding sites since 1975.

However, only about 1% of Eagle Owl pairs in Germany nest on man-made structures. In 2017 more than 50 buildings were occupied, but not all with proof of breeding. Although some buildings have been occupied by the species for up to 20 years, most are only used for short periods of time (1-2 years), probably due to disturbance.

Many of the breeding attempts were unsuccessful, particularly those in ruins or churches occupied for only 1 or 2 years. Breeding sites in industrial buildings and buildings in rock quarries and sand or gravel pits are generally used for longer periods. Eagle Owls breed on radio towers, bridges, houses, power stations, ruins, castles, churches and industrial buildings.

In recent years, Peregrine Falcon nestboxes on buildings have been increasingly used. Particularly at breeding locations in towns, Eagle Owls suffer from infection with Trichomonose/Trichomoniasis and *Herpatoplenitis infectiosastrigum*, transmitted by feral pigeons, the main prey item in such areas.

Although captive breeding and releasing into the wild of Eagle Owls is not the cause of nesting in and on buildings, as shown by the historical records, it has contributed. It can be assumed that

the nesting of Eagle Owls on buildings will strongly increase in coming years, and that a great variety of building types will be used.

10. Fine-tuning the acoustic discrimination of individuals in Little Owls

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Keywords: *Athene noctua*; acoustic monitoring; population size; limitations

Animal vocalizations contain information about individual identity that could potentially be used for the monitoring of individuals. Owls are a particularly good taxonomical group to study the potential of acoustic monitoring due to consistent, long-lasting, individual differences found in many owl species. With discriminant analysis and territorial call recordings from 54 males, we investigated several study design factors that might affect the potential of acoustic monitoring in Little Owls (Athene noctua) and selection of the most cost-effective study design. Discrimination at the level of calls (percentage of calls correctly classified) did not lead to the same results as discrimination at the level of individuals (percentage of individuals correctly classified). Hence, studies interested in individual discrimination should optimize methods at the level of individuals. We used three different call description methods based on call frequency spectrum, frequency modulation and cross-correlation. Call description based on frequency modulation allowed reliable individual discrimination in at least double-sized population than other two call description methods (54 males at least). Furthermore, recording of more calls increased linearly the discrimination of individuals. Recording of many calls did not seem necessary to get the correct discriminant function. A large number of calls could help in the case where we need to assign the sequence of calls to one of two males with similar call parameters. Unfortunately, the available pre-screening individuality index allowed only imprecise estimation of the population size that could be reliably monitored with the given methods. Overall, projects on individual acoustic monitoring need to consider the limitations regarding the population size that can be reliably monitored. For monitoring of many individuals, researchers can fine-tune their methods

on a small sample size but it is not currently possible to estimate precisely, based on a subsample, the population size for which a given methods could be reliably used.

11. Illegal bird killing and captivity of owls in Portugal

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The Mediterranean region is well known for illegal killing and possessing of live and dead birds, which is a main threat to bird species. In Portugal, this is also a relevant problem, especially to some species known for their elaborate songs and coloration. Other birds are persecuted due to their behavior, people's unsubstantiated fears and/or confrontations with humans. Raptors, including owls, are more targeted by people due to popular beliefs that these species kill domestic animals, predate game species and are important for use in obscure rituals. Some people take young raptors from nests, or as adults, to keep them illegally as captive animals.

From 2003 to 2014, we collected data on the cause of non-natural bird mortality as part of a BirdLife project addressing Illegal Bird Killing. This documented 244 reported events of illegal killing and taking of owl species. The most affected species was the Little Owl *Athene noctua* (n=114), followed by Barn Owl *Tyto alba* (n=58) and Tawny Owl *Strix aluco* (n=57), which are the most abundant owl species in Portugal. Illegal captivity (n=61) and plunder of nests (n= 115) are the most common non-lethal threats to owls. The illegal killing and capture of owls in Portugal is probably more problematic than documented in this study as it is difficult to address such a widespread and hidden practice.

12. The wintering of the Long-eared Owl in Italy

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Keywords: Long-eared Owl, Asio otus, roost, winter, Italy

In the last 10 years, the Long-eared Owl *Asio otus* has seen an expansion of its wintering range. The habit of wintering in groups allows the analysis of the Long-eared Owls' behaviour in its selection of roosts and environs. We recorded roost site selection, consistency of owl numbers at the roosts, various environmental aspects, and human disturbance. In the period 2006-2016, we catalogued 91 roosting places distributed in 11 regions and 31 provinces, one of the largest monitored area in Europe. Owl wintering was shown to be concentrated mainly in northern Italy, with the greatest number of roosts is located in the province of Venice, whilst wintering groups of owls are decreasing in central and southern Italy. The biggest roosting place (max 110 individuals) was in Puglia in a pine grove, although the number had diminished by 2016/2017. We divided the roosting places in classes by consistency in number of owls counted. Overall, 24.1% of roosts were inhabited by 1 to 3 owls, 51.6% by 4 to 10, 12.1% by 11 to 20, and 10.9% by more than 20. In particular one roost was occupied by over 50 owls. Long-eared Owls show preferences in the trees they use as roosts, with conifers being their favourites, being chosen 52.7% of the time. Of interest too was their choice of using birches (13.1%) as these trees do not offer any foliage cover as adequate camouflage during winter. The variability of the Long-eared Owl's diet has allowed an increasingly wider winter distribution in Italy, but the pattern of the last 10 years highlights their preference to live in small roosts. The increase of nesting in central and southern Italy in the last few years could favour an expansion of the wintering range, although currently roosts are concentrated in northern Italy.

13. Impact of the environment on the number of Tawny Owl *Strix aluco* territories in the MaléKarpaty mountains

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Keywords: human disturbance, afforestation, wind calamity, density, forest management

For the effective conservation of forest owls it is important to know the impact of the environmental parameters. This study is aimed on the relationship between an opportunistic predator - the tawny owl *Strix aluco* and the environment. The study area covered 44 km^2 in the oak-beech forests of the MaléKarpaty mountains, Slovakia. In the eight squares (2x2 km) tawny owl territories were recorded through use of overnight audio recordings. In the remaining three squares the owls were counted during night visits with the imitation of owl calls. The voices of owls were recorded in the autumn and spring of 2013-2016. On the study sites 34 territories were recorded (mean = 3 terr./survey square, or 0.75 terr./km^2). The relationship of the environment on the number of territories was examined using the following parameters: age of the forest cover, length of the watercourses, area of forest loss, and category of the forest management. Results did not confirm a significant influence of selected parameters on the number of territories. Within the study there were evaluated also four tree age groups, however the significant influence on the number of territories was not confirmed. Similar results were identified also for the rest of the environmental parameters. The study results support the opinion that tawny owl is an adaptable species with a wide ecological niche.

14. History of Northern Saw-whet Owl *Aegolius acadicus* in North America: First discovery to present day

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Keywords : Northern Saw-whet Owl, Migration, Acadian Owl, History

The history of the discovery of Northern Saw-whet Owls *Aegolius acadicus* is a rich one and began in 1781, with the species' classification by John Latham, who described the bird based on a specimen collected in Nova Scotia. Several years later, the saw-whet was given a Latin name: *Strix acadica*. Over the next 92 years, the literature was riddled with confusion between *S. acadica* and the similar-looking *Strix passerina*, eventually Boreal (Tengmalm's) Owl *Aegolius funereus*. Richardson and Swainson resolved the issue in their 1831 account of fauna documented during expeditions through Canada. However, confusion would continue in the form of White-fronted, or Kirtland's Owl *Nycta lekirtlandii*, first described in 1789. The mystery of this rarely encountered species was eventually solved by Robert Ridgway, who accurately proposed the true identity of Kirtland's Owl to be juvenile saw-whets. Western expansion in North America, during the mid-1800s, led to increased knowledge of the saw-whet's range in the Rocky Mountains, providing connectivity with specimens collected in mountains of southern Mexico. Additional discoveries of the bird's life history (breeding accounts, extant autumn and winter records) led to the speculation that saw-whets were migratory. It was not until the early 1900s that sound evidence for this belief was acquired and, even then, extensive banding efforts did not occur until the 1950s. Before 1986, all banding efforts involved passive mist-netting and provided mixed results. After 1986, the use of an audio lure became standard protocol, increasing capture rates dramatically. Today, researchers are studying saw-whet owls across North America, adding knowledge to the secretive species' still mysterious life history. Here, we present more than 200 years of history of the Northern Saw-whet Owl, its discovery, classification, range, migration, and more.

15. Study of Eagle Owl *Bubo bubo* Population in Central and Northern Ribatejo, Portugal

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Keywords: Feeding; Breeding; Ribatejo; Nesting; Territories

For more than 20 years we have been studying the Eagle Owl *Bubo bubo* in Central and Northern Ribatejo, Portugal, as a proactive volunteer citizen-scientist program. The 1,555 km^2 study area included the municipalities of Abrantes, Alcanena, Alpiarça, Constância, Entroncamento, Ourém, Tomar and Vila Nova da Barquinha. The habitat was characterized by limestone or sandstone soil types and mainly vegetated by Mediterranean scrubland, cork oak woodland, pine and eucalyptus plantations. The program goal was to document and determine the number of occupied Eagle Owl nesting and non-nesting territories, and to describe the owl's diet and breeding success. We conducted a literature review, collected information on owl locations from the local residents, and then confirmed published and anecdotal records thus obtained through direct observation. We visited occupied owl territories to collect prey remains and pellets at nests and recorded evidence of reproduction. In 2015, seven nests were regularly monitored. Mean clutch size was 2.42 eggs (range 1 to 3). Average breeding success was 2.28 fledglings per breeding pair. Prey use was variable and was related to habitats around nest sites.

The main prey were rabbits, rats, and partridges. A total of 15 nesting territories and 13 non-nesting territories were documented up to 2017. The conservation of Eagle Owls in this area, depends on humans maintaining ecologically balanced habitats and therefore educating and engaging local people and especially school children. We will develop concerted actions including workshops, training, and observations with multidisciplinary teams and in partnership.

16. Variation in the abundance of the Barn Owl *Tyto alba* in the Tagus Estuary: Effect of land use, grazing and soil interventions

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Keywords: Barn Owl; Abundance; Land Use; Grazing; Soil Interventions

The South Floodplain of Vila Franca de Xira is of high importance for the Barn Owl *Tyto alba* during the post-natal dispersal period, a phase of the life cycle when the condition of individuals is crucial for survival. The objective of this study was to evaluate the temporal and spatial variation in Barn Owl abundance in the floodplain relative to land use, cattle grazing (stocking rate and length of stay), and soil interventions (surface tillage, deep tillage and seeding).

From 2007 to 2014, between August and December, we repeated a 22.2 km long nocturnal owl survey transect by car 97 times. The transect was divided into four sections, representative of land use in the area: a rice field section and three sections with different levels livestock management (stocking density and temporal use). Within these sections, plots (areas with one "constant" land use) were identified and noted. The variables were associated with the plot and grouped by section and by season. Statistical analysis was based on the comparison of linear mixed effect models using the Akaike information criterion (AIC), with the section as random factor.

Barn owl abundance is 1.21±2.60 ind/km in grazed pastures, 1.13±1.48 ind/km in ungrazed pastures, and 0.97±1.48 ind/km in rice fields. Both land use and the presence of cattle contributed to explain the variation in owl abundance; the former assumed greater importance in summer (Akaike weight wi=0.81; fall: wi=0.51) whereas the latter assumed greater importance in the fall (wi=0.78; summer: wi=0.67). In areas with cattle, the effect of grazing season (ΔAIC=0, wi=0.67) overcomes the effect of stocking density (ΔAIC> 4; wi=0.07) and temporal use (ΔAIC>

10; wi=0). Soil interventions appear not to influence the general pattern of Barn Owl abundance in the area. The results suggest the need to explore the effect of other variables related to the spatial distribution of cattle in the plots.

17. Monitoring organochlorine compounds in feathers and livers of Barn Owls *Tyto alba* from South Portugal: Variations with sex and age

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Keywords: Barn Owl; Organochlorine Compounds; Feathers; Liver

Organochlorine compounds (OC) include the most prevalent synthetic pesticides that have been broadly used in agriculture in the second half of the 20th century. Given its preference for farmland hunting grounds the Barn Owl *Tyto alba* is a good candidate to biomonitor the potential health risks of OC to humans and wildlife. We evaluated the efficacy of Barn Owl feathers and livers for monitoring OC and sex and age class differences.

Primary feathers and livers from 15 owls collected along roads (2009 to 2013) were analyzed for 14 OC (α-HCH, ß-HCH, δ-HCH, lindan, heptaclor, heptaclor epoxide, endosulfan I and II, aldrin, dieldrin, endrin, DDD, DDE and DDT). Wilcoxon matched pairs tests were used to compare between feathers and livers from each individual and Mann-Whitney tests were used to compare differences between sexes (8 females and 5 males) and age classes (6 first year and 9 older birds). The most abundant compounds in our study were β-HCH (4587±4528 ng g-1) and heptachlor (2530±2501 ng g-1) measured in feathers, representing respectively 55 % and 31 % of the sum of OC in our sample. All OC were detected in feathers, while in livers δ-HCH, DDT and DDD were not detected. DDE (45.39±50.37 ng g-1) was the compound with higher mean concentration in livers. We detected no differences between sexes (feathers and livers) and age classes (feathers) but in livers first year barn owls had higher levels of heptachlor epoxide (1.22±1.16 ng g-1; w=44.5;

p=0.02) and endrin (31.9±54.7 ng g-1; w=49.5; p>0.01) than older birds (heptachlor epoxide: 0.209±0.440 ng g-1; endrin: nd).

Feathers allowed for detecting mean concentrations 45.6 times superior than in livers (from 0.1 for DDE up to 300 times superior for β-HCH); using livers alone would have missed 21% of the OC present in owls.

18. The summer diet of the Snowy Owl *Bubo scandiacus* in Iceland.

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Keywords: birds; food; mammals; pellets; prey; raptor

The Snowy Owl *Bubo scandiacus* is a rare resident species in Iceland and nests are found intermittently. This is unusual as lemmings, the prime prey of the Snowy Owl, do not occur in Iceland. We studied summer diets from three known breeding sites in Iceland by analysing pellets, and identified in total 235 prey items (72 kg). Birds (97% by number) made up the most part of the diet. The Rock Ptarmigan *Lagopus muta* was the prime prey species. Waders were important prey and passerines and waterfowl were also taken. Wood Mice *Apodemus sylvaticus* were taken occasionally and an Arctic Fox *Vulpes lagopus* pup was found at one site. Adult birds made up 61 % and chicks 36 % of the diet by number.

19. Comprehensive molecular phylogeny of Barn Owls and relatives (Family: Tytonidae)

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Keywords: bird; strigiformes; phylogenetics; taxonomical classifications

The owl family Tytonidae comprises two genera: *Phodilus*, limited to the forests of central Africa and South-East Asia, and the ubiquitous *Tyto*. The genus *Tyto* is majorly represented by the cosmopolitan Common Barn-Owl, the "Tyto alba species complex", with more than 30 recognised subspecies worldwide. Discrete differences in body size and plumage colouration have led to the classification of this family into many species and subspecies, but the taxonomic status and phylogenetic relationships between taxa remain unclear and in some groups controversial. Although several previous studies attempted to resolve this, they have been limited in their taxonomic and geographical coverage, or have relied on restricted molecular evidence and low sample sizes. Thus, our main questions in this study were: 1) What are the phylogenetic relationships and classification status of the whole family?; and 2) When and where did the most important speciation events occur? Based on the most comprehensive sampling to date (all currently recognised 13 *Tyto* species, 50 out of 52 subspecies, and one *Phodilus* species), and a multi-locus approach using seven mitochondrial and two nuclear markers, we analysed the phylogenetic relationships of this family taking advantage of field data and museum collections available worldwide. We confirm that the Common Barn-Owl “Tyto alba species complex” is divided into three main evolutionary units: 1) The American Common Barn-Owl *T. furcata*; 2) The Afro-European Common Barn-Owl, *T. alba*; and 3) the Australasian Common Barn-Owl, *T. javanica*, and suggest an Early Pliocene (ca. 10 mya) Australasian and African origin of the species complex. Our results are supported by fossil age information, given that the most recent

common ancestor between the Tytonidae genera *Phodilus* and *Tyto* was probably from the Middle Eocene (ca. 44 mya) of Australasia.

20. Occurance of Barn owl *Tyto alba* parasites in the Netherlands: A recent survey

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Keywords: Barn Owl; Parasitology

This paper reports on a survey to determine the occurance of parasites in dead Barn Owls sent in to the Barn Owl Foundation by answering the question if there is a connection between the parasite load and the cause of death? During a 2 year period 109 dead Barn Owls were collected by volunteers in The Netherlands of which 17 were no longer suitable for analysis due to severe mechanical damage or advanced autolysis. 92 were processed macroscopically, externally, and internally by autopsy. Mites, ticks and lice were identified and counted. 7 different internal parasites were determined by courtesy of Drs.H. Cremers, veterinary parasitologist at the University of Utrecht. Nematoda C.americana and S.laticeps were frequently found, as well as Capillaria spec. and low numbers of Acanthocephalus spec. and Porrocaecum angusticolle. Since most of the birds were traffic casualties the results are difficult to interpret.. The condition of the available material varied a lot. For logistic reasons nearly all the birds had been (deep) frozen wich prevented the use of cytological methods. Furthermore exoparasites may quickly leave the birds post mortem as the body cools down. Despite some methodological shortcomings we think that this survey may give a reliable impression of the average parasite load of Barn Owls in The Netherlands. The fact that owls with reduced condition might be forced to forage alongside roads and therefore have a greater risk of getting hit by traffic, cannot be compensated for by this method.

21. The influence of weather conditions and forest management on the number of Tawny Owls *Strix aluco,* a case study from eastern Poland

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Keywords: *Strix aluco*, density, weather, forest management, Poland

The main objective of our research was to examine whether forest management and basic weather factors affected the size of the Tawny Owl *Strix aluco* population. We investigated whether the forestry operations, habitat, food abundance, temperature and snow cover affect the number of owl's territories. The field research on the Tawny Owl population was conducted near Lublin (51°30'N, 22°35'E) in eastern Poland. The research was carried out from 2007 to 2014 with the use of the standard playback method on a sample plot covering 50 km^2. Three night counts were conducted every year from February to April. A total of 181 territories were found during the study period and significant fluctuations of the Tawny Owl population density were observed. The number of territories varied from 3.8/10 km^2 to 6.2/10 km^2. Seventy percent of the study area is covered by coniferous woodland. However, the analysis of the habitat preference identified a significant preference of owls for oak-hornbeam forest. In the seasons with heavy snowfall and extremely low temperature (2010 and 2013), the number of occupied territories was lower, but this relationship was not statistically significant. During all study seasons, owls from 98 territories (54%) started the breeding season despite forestry operations carried out in the vicinity. Both weather factors and forest management had no negative effect on the breeding density of the Tawny Owl in the study area ($p \geq 0.5$). The number of territories was higher in the seasons with high seed production (i.e., 2009, 2011, 2012). Seeds of oaks are the main food for forest rodents and the breeding density of the Tawny Owl is strongly correlated with the density of small rodents ($r = 0.98$, $p = 0.000015$).

22. 10 years of monitoring a Tawny Owl *Strix aluco* population in oak forests of Eastern Ukraine

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Keywords: Tawny Owl; *Strix aluco*; monitoring; territoriality; nest box

A population of Tawny Owls *Strix aluco* was monitored from 2002 to 2011 in a 870 ha Oak forest plot in the "Gomilsha Forests" National Park (Eastern Ukraine). The monitoring program included yearly bird censuses with mapping of their territories; annual checking of 19 nest boxes and up to 150 natural hollows, three times a year. Pellets were collected under roosts and occasional hunting perches.

Estimated breeding density was 2.5 pairs/km^2, which is higher than that of other areas in the region. Mean area of breeding territory according to mapping data was 41.7±9.4 ha. The studied population was stable with yearly fluctuations reaching ±5.5% of mean number of pairs and without any significant trend. Birds avoided territories with mean forest stand age less than 60 years (χ^2 = 4.66, $p<0.05$). Bank Vole *Myodes glareolus* and Yellow-necked Mouse *Apodemus flavicollis* formed the basis of the Tawny Owl's diet (30.8% and 20.7% respectively). Birds, *Microtus* voles and Common Spadefoot *Pelobates fuscus* were the most abundant alternative prey. The proportion of prey species inhabiting open grasslands significantly increased near forest edges (Spearman R = -0.76; $p<0.05$): in snowy winters the proportion of this prey group also increased compared to woodland rodents (Spearman R = -0.96; $p<0.01$), possibly indicating changes of hunting habitats. The diet composition in territories near forest edges and in old-growth stands was more diverse.

Suitable tree hollows were abundant in the study area compared to nest boxes (0.8 nest boxes/territorial pair and 2.1 used hollows/territorial pair). Mostly there were relatively small cavities in heavily decayed trees suitable only for day roosting (90%). Hollows suitable for nesting were located in older trees and comprised more limited resource (10%). This study area

represents optimal habitat for Tawny Owls in the region, where birds reach high densities, have variable hunting conditions and good availability of natural shelters.

23. Prey caching of the Boreal Owl *Aegolius funereus beickianus* at Lianhuashan in Gansu, China

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Keywords: Boreal Owl, Prey Caching, Clutch Size, Nestling Weight, Lianhuashan

The Boreal Owl *Aegolius funereus* has a circumpolar distribution, inhabiting conifer forest in northern hemisphere, and its breeding biology and behavioral ecology have been well studied in Europe and North America. However, the knowledge of its endemic subspecies *A. f. beickianus* in the Himalayan conifer forest is quite limited. Here, we studied the prey caching of *A. f. beickianus* in 67 nest boxes in the Lianhuashan Nature Reserve in Gansu Province during the 2003-2008 and 2017 breeding seasons. We recorded and identified prey species that were cached in nest boxes. We also measured nestling weight. A total of 35 active nests were recorded from 2003 to 2008 (mean 5.83 nests/year). Mean clutch size in the same period was 2.8±0.7 (n=30). However, in 2017, we found two nests each with two egg clutches resulting. The mean clutch size for 7 years at Lianhuashan was 2.75±0.78 (n=32), much smaller than that reported in Europe (4-8) and North America (3.25). Prey caching in 2017 was quantified as 0.76 ±0.8 prey items/nest/day, less than the mean value in 2004 (0.83±1.29 prey items/nest/day). Mean nestling weight in 2017 (98 g) was also less than that recorded in 2004 (110 g). In 2017, heavy precipitation in spring, followed by dry and hot weather in summer, possibly reduced small mammal prey abundance than in previous years of this study. This may have resulted in fewer active nest boxes, smaller clutch size, less prey caching and smaller nestling weight. Boreal Owls at Lianhuashan appear to produce fewer young in years of relatively poor prey availability which is similar to its breeding strategies reported in other parts of its range.

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