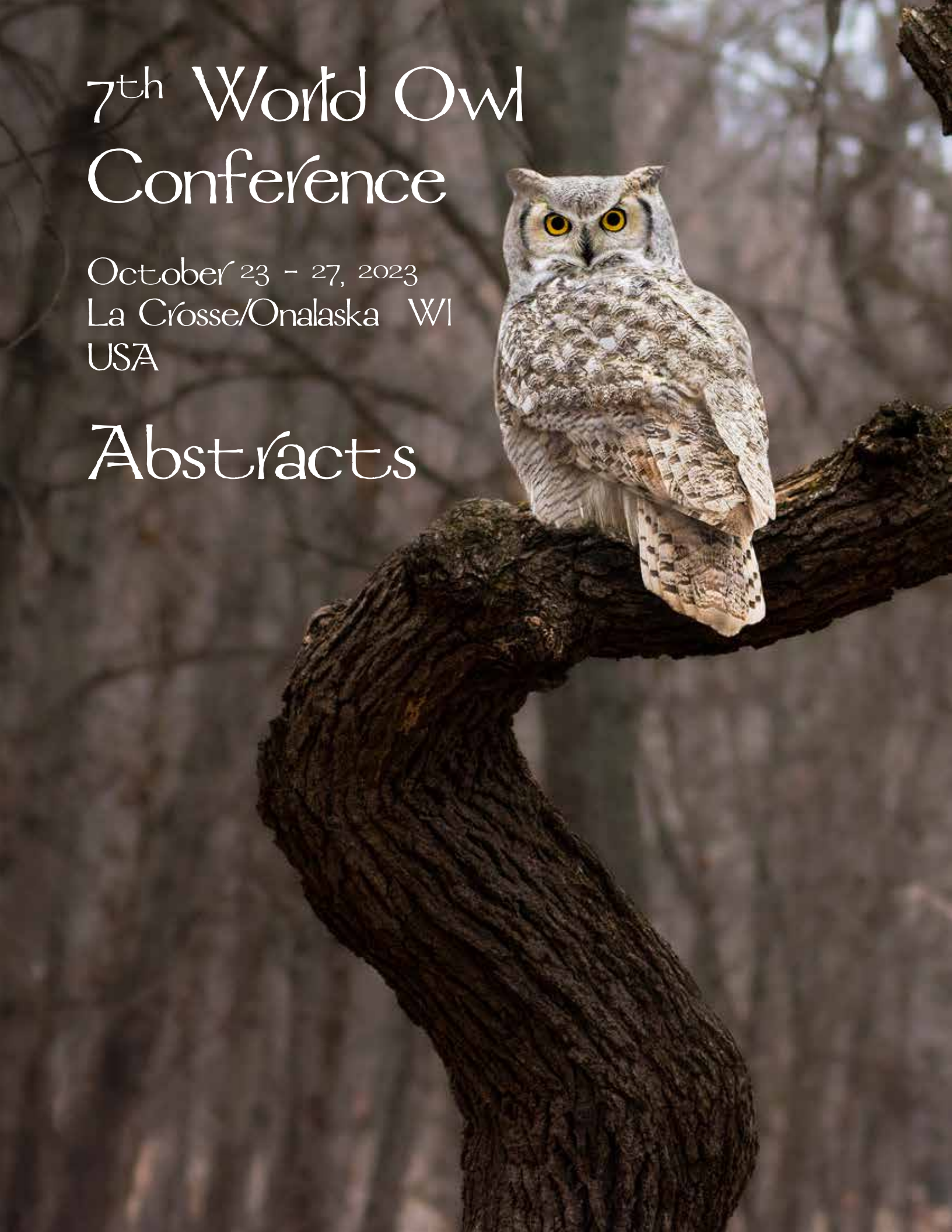
7th World Owl Conference

October 23 - 27, 2023
La Crosse/Onalaska WI
USA

Abstracts



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7th World Owl Conference
Stoney Creek Hotel
La Crosse/Onalaska, Wisconsin USA
23-27 October 2023

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Front cover: Great Horned Owl. Photo: Jeff Grotte.
Rear image: Male Great Grey Owl bringing common vole to nest.
Photo: Roar Solheim.
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Layout: Norsk Naturreportasje/Roar Solheim.
Print: CBS Graphics (La Crosse, WI) October 2023.

Locally produced nametags

Your nametags are made from the branches of 80+ year-old Norway spruce trees on Hein and Karla Bloem's property that died due to too many years of weather extremes. Bloem's neighbor, Dennis Kinstler, sliced the branches into tree cookies. Owl Center educator Jo Severson modified the conference logo and Viterbo University students laser-engraved the logo into the tree cookies. Houston resident and leather worker Kathi Schultz procured and cut the leather for the straps and staff and volunteers tied the cords. Volunteer Jo Hidaka hand-lettered each nametag. We hope you will keep and enjoy them as souvenirs of this conference.

Conference program

Monday 23 October

8:30 Dissection Workshop at UW-L.

9:00 Wildlife Acoustics Workshop.

10:00 **BREAK**

10:20 Wildlife Acoustics Workshop (continued), Dissection Workshop at UW-L (continued).

12:00 **LUNCH**

13:00 Welcome.

13:10 Falé: Wintering patch selection of nomadic owls: Short-eared Owl (*Asio flammeus*) area selection in Portugal.

13:20 Miller: Temporal and spatial population dynamics of the nomadic Short-eared Owl (*Asio flammeus*) across the western United States.

13:40 T. Poole: Short-eared Owl (*Asio flammeus*) conservation status in Manitoba, Canada.

14:00 Garcia-Heras: Movement Ecology and habitat use of Pueo (Hawaiian Short-eared Owl, *Asio flammeus sandwichensis*) in Hawai‘i.

14:20 Kämpfer: Habitat preferences and survival rates of Short-eared Owls (*Asio flammeus*) in natural refuge habitats of Central Europe.

14:40 Falé: Trophic niche of wintering Short-eared Owls (*Asio flammeus*) in Portugal.

15:00 **BREAK**

15:20 Mendelsohn: Methods for documenting nest failure in Short-eared Owls (*Asio flammeus*) in western Montana using novel nest cameras.

15:40 Duncan: Video assessment of an audio recorder to quantify Northern Saw-whet Owl (*Aegolius acadicus*) nesting behavior in southern Manitoba, Canada.

16:00 Luoma: Differential timing of migration in Northern Saw-whet Owls (*Aegolius acadicus*) in central Wisconsin based on age and sex categories.

16:20 Sheffield: Exposure and effects of lead in owls: a comprehensive review.

Tuesday 24 October

9:00 Keynote: David Johnson: Results of a 15-year demographic study of Burrowing Owls (*Athene cunicularia*) in north-central Oregon, USA.

10:00 **BREAK**

10:20 Duncan: Home range, habitat use, diet, and dispersal of breeding captive-released and wild Burrowing Owls (*Athene cunicularia*) in Manitoba, Canada, 2010-2012.

10:40 Mendes: Reproductive ecology of urban Burrowing Owls (*Athene cunicularia*) in Paraná, Brazil.

11:00 Jennings: Effects of passive relocation on urban Florida Burrowing Owls (*Athene cunicularia floridana*).

11:20 Mckinnon: Review and lessons learned over 40 years of captive bred reintroduction of the Western Burrowing Owl (*Athene cunicularia hypugaea*) in the grasslands of British Columbia, 1983-2023.

11:40 Esclarski: Morphological variations between the Burrowing Owl (*Athene cunicularia*) subspecies from Brazil.

12:00 **LUNCH**

13:00 Wisinski: Burrowing Owl (*Athene cunicularia hypugaea*) monitoring, conservation, research, and translocation in San Diego County, California, USA.

13:20 M. Poole: Safe and ethical distances when using blinds for filming/photography of nesting Burrowing Owls (*Athene cunicularia*).

13:40 Johnson: Updated Western Burrowing Owl (*Athene cunicularia hypugaea*) breeding distribution map in North America.

14:00 Johnson: Advances in Burrowing Owl (*Athene cunicularia*) capture techniques.

14:20 Johnson: Effects of land use and artificial light (streetlights on the nesting distribution of Burrowing Owls (*Athene cunicularia*) in Cape Coral, Florida, USA.

14:40 Sailas: Provisioning rates and prey composition of a declining predator, the Little Owl (*Athene noctua*), in contrasting European farmlands.

15:00 **BREAK**

15:20 van Harxen: 50 Years reproduction of the Little Owl (*Athene noctua*) in the Netherlands.

15:40 Van Nieuwenhuyse: Current insights into the taxonomy and geography of the Little Owl (*Athene noctua*).

16:00 Van Nieuwenhuyse: Little Owl 2.0 book.

16:20 Bloem: The complete vocal repertoire of the Great Horned Owl (*Bubo virginianus*) and associated behaviors in North America.

16:30 Hartley-Cox: Nest-site selection, home range and resource use of Great Horned Owls (*Bubo virginianus*) in the mixed-grass prairie of Saskatchewan.

16:40 1-minute video from Wildlife Acoustics.

18:00 - 20:00 **POSTER SESSION**

Revels: Oklahoma's secret bird: the Northern Saw-whet Owl (*Aegolius acadicus*).

Garcia-Heras: First confirmed depredation of Aeʻo (Hawaiian Stilt, *Himantopus mexicanus knudensi*) by Pueo (Hawaiian Short-eared Owl, *Asio flammeus sandwichensis*) in Hawaiʻi.

Wiley: Depredation of sea birds by invasive American Barn Owls (*Tyto furcata*) on Kauwai, Hawaii: diet quantifications from stable isotope analysis.

Brennan: Home range size and habitat use of a recently established Long-eared Owl (*Asio otus*) population in Iceland.

Falé: Structured citizen science to unravel the distribution of wintering Short-eared Owls (*Asio flammeus*) in Portugal.

Falé: Beyond vermin: Update of direct threats to non-breeding Short-eared Owls (*Asio flammeus*) in Iberia.

Baranowski: Foraging habitat of breeding Flammulated Owls (*Psiloscops flammeolus*) in the Wasatch Mountain range.

Lindner: Information on the use of rodenticides as it relates to owls in Europe.

Le Fay: A photographic guide to aging Snowy Owl (*Bubo scandiacus*) chicks from hatching to fledging in Utqiaġvik, Alaska.

Wednesday 25 October

9:00 Keynote: Marjon Savelsberg: A spectrographic overview of adult Eurasian Eagle Owl (*Bubo bubo*) vocalizations and behavior in southern Limburg, the Netherlands.

10:00 **BREAK**

10:20 Daugherty: Comparing morphometric data of owls within the Barn Owl (*Tyto alba*) complex to illuminate taxonomic and phylogenetic relationships globally.

10:40 van den Burg: Prey as a determining factor for the success of Barn Owls (*Tyto alba)* in Friesland, The Netherlands.

11:00 Bloem: Using acoustic monitoring to document Barn Owl (*Tyto furcata*) range expansion in southeastern Minnesota and southwestern Wisconsin.

11:20 Brown: Status update for the American Barn Owl (*Tyto furcata*) in the mid-Atlantic United States.

11:40 Sheffield: Prey selection and reproduction in Barn Owls (*Tyto furcata*) inhabiting an arsenic-contaminated hazardous waste site in Texas, USA.

12:00 **LUNCH**

13:00 Therrien: Status assessment and conservation priorities for the Snowy Owl (*Bubo scandiacus*) across its circumpolar range.

13:20 Wiedensaul: Project SNOWstorm at 10: building collaborative, crowdfunded owl research.

13:40 Wiedensaul: Environmental contaminants in a top arctic predator: a decadal monitoring of Snowy Owl (*Bubo scandiacus*) health.

14:00 Baalsrud: The evolution of the Snowy Owl (*Bubo scandiacus*) genome and its unique landscape of genomic repeats.

14:20 Enevoldsen: Unraveling the evolutionary adaptations of the Snowy Owl (*Bubo scandiacus*) using a unique combination of population and comparative genomics.

14:40 Jacobsen: Some breeding site fidelity in Snowy Owls (*Bubo scandiacus*) in Fennoscandia documented by genetic analyses.

15:00 **BREAK**

15:20 Miller: Flammulated owl (*Psiloscops flammeolus*) occupancy, detectability, and forest use during the breeding season in the western United States.

15:40 Tendler: Parental provisioning and resource variation in Flammulated Owls (*Psiloscops flammeolus*) breeding in northern Utah.

16:00 Mika: Insect prey diversity, biomass, and parental foraging efforts in Flammulated Owls (*Psiloscops flammeolus*) of northern Utah.

16:20 Smith: Why including children in owl research is important to inspire the next generation of researchers.

16:40 Rich: What do U.S. birders know about bird conservation needs?

18:00 **BANQUET**

19:00 Hooting Contest

19:40 Keynote: Denver Holt: Highlights of 37 years of Long-eared Owl (*Asio otus*) research in Montana.

Thursday 26 October

9:00 Keynote: Fred & Henk Jan Koning: How the Tawny Owl (*Strix aluco*) survives in a changing landscape: a 63-year study of raptor populations in The Netherlands.

10:00 **BREAK**

10:20 Duncan: Barred Owl (*Strix varia*) activity and diet recorded with a camera trap at a natural cavity nest in Manitoba, Canada.

10:40 Campbell: Characterizing Barred Owl (*Strix varia*) diet at the invasion front in California and midwestern native ranges of the United States.

11:00 Fountain: Genetics-based assessment of California Spotted Owl (*Strix occidentalis occidentalis*) demography in southern California.

11:20 Solheim: Do owls of a feather molt together? Molt and aging of Great Grey owls (*Strix nebulosa*) in Scandinavia.

11:40 Vrezec: Climate change and owl interactions: case study of sympatric *Strix* owls.

12:00 **LUNCH**

13:00 Göçer: Scops Owl (*Otus scops*) Migration from Turkey, Slovenia, and Spain.

13:20 Esclarski: Courtship observations and mating display of the Buff-fronted Owl (*Aegolius harrisii*) in southern Brazil.

13:40 Buers: Western Screech-Owl (*Megascops kennicottii*) nest site selection in a warming world: The importance of thermal refugia in British Columbia, Canada.

14:00 Guzman: Design of the urban and industrial gardens based on Ferruginous Pygmy-Owl (*Glaucidium brasilianum*) behavior at Costa Rica Central Valley.

14:20 Wu: Effects of night safari on the vocalizations of Lanyu Scops Owl (*Otus elegans botelensis*) on Lanyu Island, Taiwan.

14:40 Hsu: Acoustic niche differentiation of sympatric Mountain Scops Owl (*Otus spilocephalus*) and Collared Owlet (*Glaucidium brodiei*) in eastern Taiwan.

15:00 **BREAK**

15:20 Toutonghi: Northern Hawk Owl (*Surnia ulula caparoch*) winter habitat use and movement in Minnesota and Manitoba.

15:40 Mendes: Alteration in the use of a dead tree hollow by two species of owls in an urban area in Brazil.

16:00 Koenrads: Ecomorphology and niche differentiation among North American and European owls Utah.

16:20 Wrap up.

1

Foraging habitat of breeding Flammulated Owls (*Psiloscops flammeolus*) in the Wasatch Mountain range

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Flammulated Owls (*Psiloscops flammeolus*) are small insectivores that are of conservation concern due to climate change, shifts in habitat, and fluctuating resources. Flammulated Owls in northern Utah tend to occupy different habitats compared to other populations in the American West. Our research question was to evaluate where male owls were foraging during the nesting period to better understand how habitat characteristics influence foraging behavior. We deployed GPS trackers on males during incubation and nestling periods which were programmed to collect location data at likely foraging peaks. The locations provide the basis for generating models on preferences in foraging habitats and abundance of nocturnal invertebrates. Analyses suggested that male owls preferred to forage in patches with high herbaceous plant richness and reduced amounts of canopy cover which supported nocturnal moth abundance. Additionally, we found that the two study areas differed significantly in woody plant richness. While evaluating mean distances traveled from the nest to foraging sites, we found tree density, herbaceous species richness, and nocturnal moth biomass may all predict the movement patterns of the owls. Density maps were created to visualize foraging activity gradients. Foraging territory sizes were predicted by canopy cover and woody species richness. These data provide valuable information on how to support and manage habitats for this unique owl species.

Key words: Flammulated Owls, life history, habitat characteristics, foraging behavior, GPS trackers.

2

The complete vocal repertoire of the Great-Horned Owl (*Bubo virginianus)* and associated behaviors in North America

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Knowledge of vocalizations and associated behaviors of nocturnal and crepuscular species is a helpful tool when studying these species in the wild or working with them in captivity. Our goal was to document the complete vocal repertoire of the Great-Horned Owl (*Bubo virginianus*) to understand both wild and captive owls better, and to build on the initial research the lead author presented at the World Owl Conference in 2007. Over the course of the past 18 years we and many volunteers observed and recorded 10 captive owls in breeding and non-breeding situations; made year-round recordings of all 18 wild owls occupying a single area in rural Houston, Minnesota over the duration of the study; observed 5 online Great Horned Owl cams (in Oklahoma, Georgia, Wisconsin, California and Alberta); went to 139 active Great Horned Owl nests with banders in Saskatchewan; and reviewed most recordings of the species in the major and minor sound libraries. The sounds they produce can be classified into 5 main categories based on inflection, number of syllables, duration, pitch, volume, method of producing sound and behavioral context: hoots, squawks, chitters, squeals, and non-vocal sounds, with multiple types within each category. Their vocalizations can reveal age, sex, individual identification, behavior, and are important when considering potential species splits.

Key words: Great Horned Owl, Bubo virginianus, vocalizations, repertoire, behavior.

Great Horned Owl, male hooting, The Everglades, Florida.

3

Using acoustic monitoring to document Barn Owl (*Tyto furcata*) range expansion in southeastern Minnesota and southwestern Wisconsin

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Barn Owls (*Tyto alba*) have generally been considered extralimital in Minnesota. Over multiple years volunteers and I detected Barn Owl calls on security cameras I use to record behaviors and vocalizations of captive Great Horned Owls (*Bubo virginianus*) at International Owl Center facilities in Houston, Minnesota. In 2020 I deployed 2 Automated Recording Units (ARUs) in southeastern Minnesota from spring through late fall, moving them roughly every 2 weeks to test if it was possible to detect Barn Owls in other locations using acoustic monitoring. In 2021 I acquired 4 more ARUs and placed all 6 at fixed locations. In 2022 I placed them at other fixed locations, including southwestern Wisconsin. In total I detected Barn Owls at 12 locations in southeastern Minnesota and southwestern Wisconsin. At sites within flying distance of known recent nests or roosts I detected Barn Owl calls on up to 58% of nights monitored. At sites with no previously known Barn Owl activity, detection rates were as high as 5.8% per recorder-night. Ninety-four percent of all detection-nights were in spring and fall between 28 February to 1 June and 9 September to 11 November. Of the 31 reports of Barn Owls accepted by the Minnesota Ornithologists' Union since 1990, 17 (55%) were audio recordings, 7 (23%) were photographs, 6 (19%) were dead specimens and 1 (3%) was a written description. Passive acoustic monitoring has thus far proven to be the most effective way to document the expansion of this nocturnal, secretive species in this area of range expansion.

Key words: Barn Owl, Tyto alba, ARUs, range expansion.

4

Home range size and habitat use of a recently established Long-eared Owl (*Asio otus*) population in Iceland

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Little knowledge currently exists regarding the Long-eared Owl (*Asio otus*) population newly breeding in Iceland. Despite the population's recent success, Iceland differs greatly from the species' typical range. In the northernmost latitudes of its range, the Long-eared Owl inhabits boreal forests dominated by conifers. Though Iceland falls within the boreal latitudes, only 2% of its total land area is forested. Of these forests, birchwood constitutes the majority (>75%), while conifer forests comprise a significantly smaller proportion. Additionally, Iceland has very few apex predators in comparison to the Long-eared Owl's typical range. This allows for a unique natural setup where habitat can be assessed as a limiting factor without considerable impact from natural predators and interspecific competition. To understand the Long-eared Owl's success in Iceland, it is imperative to examine how it is using this particular ecosystem. The primary objective of this

study is to investigate the home range size and habitat use of Long-eared Owls during the breeding season in Iceland. A total of eight Long-eared Owls have been fitted with GPS transmitters, comprising of seven Interrex MINI transmitters and one Ornitela transmitter. These are expected to provide unbiased estimates of owl positions during summer 2023. Minimum convex polygon (MCP) will be used to define the home range for each owl. Habitat use will be determined both at the larger scale – comparing home range composition to the South Iceland region – and the small scale – within the confines of the home range for each owl.

Key words: Long-eared Owl, GPS telemetry, home range, habitat use, Iceland.

5

Status update for the American Barn Owl (*Tyto furcata*) in the mid-Atlantic United States

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The American Barn Owl (*Tyto furcata*) is listed as a species of Least Conservation Concern by the IUCN and considered Secure by the U.S. Fish and Wildlife Service in the United States. However, severe declines have been evident particularly in the eastern and mid-western United States. Western U.S. populations appear to be mostly stable. Currently, 11 states list the Barn Owl as Endangered or Imperiled at the S1 rank, 24 states list them as a "Species in Need of Conservation" at the S2/S3 level, and 3 states consider them to be declining. Only 10 states list the Barn Owl as Stable at a ranking of S4 or higher. Populations have been declining for decades primarily due to loss of rodent habitat – grassland/wetland - and loss of nest sites within range of quality foraging habitats. We present the most recent Breeding Bird Atlas data to illustrate the distribution and abundance of Barn Owls in Delaware, Maryland, New Jersey, Pennsylvania and Virginia. In response to the Maryland Bird Conservation Partnership's Farmland Raptor Program goal of assessing the current nesting status of Barn Owls in Maryland, we show compiled historic nest site, Breeding Bird Atlas, eBird, and recent breeding season data to create a comprehensive confirmed nesting record of Barn Owls in the state. Additionally, we offer insights on trap design and variables influencing trapping success from a three-year effort in Maryland. We also share preliminary findings gathered on recruitment, mate and nest-site fidelity, and age structure from the sampled population.

Key words: Barn Owl, Tyto furcata, distribution, abundance, nesting, trapping.

6

Western Screech-Owl (*Megascops kennicottii*) nest site selection in a warming world: The importance of thermal refugia in British Columbia, Canada

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Anthropogenic climate change is altering the severity and intensity of extreme heat events globally, with nighttime temperatures rising more dramatically than daytime temperatures. However, little research has assessed how temperature influences biological decisions in nocturnal animals. Identifying thermal refugia, areas that mitigate against extreme temperature fluctuations, has emerged as a potential means for wildlife to cope with the risk of hyperthermia by seeking cooler microclimates. To investigate whether owls select for thermal refugia, we identified Western Screech-Owls (*Megascops kennicottii*) nests in southcentral British Columbia, Canada. We used temperature loggers to monitor the temperature (°C) and relative humidity (%) of nest sites and compared them to randomly located cavities within the owl's territory. We calculated the thermal buffering capacity of sites based on the time it took sites to heat up or cool down and compared the forest structure and tree species composition of the site's canopies. Our findings suggest that owls have a slight preference for nest sites with greater canopy closure and canopies with a higher proportion of birch trees *(Betula* sp.). We also found that the presence of birch trees significantly improved thermal buffering at night in riparian areas. Birch ecosystems are of conservation concern in southcentral British Columbia, and our study suggests a potential novel ecosystem service that has not yet been explored. Our findings provide insight into the role of thermal refugia in mitigating the impacts of extreme heat on wildlife, and the importance of conserving birch ecosystems as a potential refuge for Western Screech-Owls.

Key words: nest selection, refugia, climate change, Western Screech-Owls.

Eastern Screech-Owl, USA.

7

The evolution of the Snowy Owl (*Bubo scandiacus*) genome and its unique landscape of genomic repeats

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Bird genomes are known to be relatively repeat-poor and stable in terms of size and gene synteny compared to other vertebrates. However, with the appearance of more avian chromosome-level assemblies, we

can now investigate the full spectrum of genomic repeats and the evolution of genomic architecture in previously unexplored lineages such as owls (Strigiformes). We have generated a gold-standard genome assembly for the Snowy Owl (*Bubo scandiacus*) using PacBio, ONT, and Hi-C as part of the Earth Biogenome Project Norway. We found that the relatively large snowy owl genome (1.6 Gb) has the highest proportion of repeats reported for any bird genome to date (28.34% compared to an average of ~10% in other birds). We compared the repeat content of the Snowy Owl genome with other bird genomes of chromosome-level in a phylogenetic framework; Barn Owl (*Tyto alba*), California Condor (*Gymnogyps californianus*), Northern Goshawk (*Accipiter gentilis*), Downy Woodpecker (*Dryobates pubescens*), Northern Carmine bee-eater (*Merops nubicus*), Zebra Finch (*Teaniopygia guttata*) and Chicken (*Gallus gallus*). The main bulk of the snowy owl genomic repeat landscape consists of transposable elements (superfamily endogenous retroviruses - ERVs), which in some chromosomes form large chunks of up to 5Mb of centromeric satellite DNA. These ERV-like centromere sequences are only found in the *Bubo* lineage and seem to be species-specific, they could therefore have implications for reproductive isolation and speciation in this lineage, as well as genomic stability. Our findings reveal a highly dynamic evolutionary history of the snowy owl genome characterized by high transposable elements activity and repeat expansions. This study highlights the need for more in-depth comparative genomic analyses in owls using high-quality genome assemblies to understand the diversification and evolution of this lineage.

Key words: evolution, comparative genomics, speciation, Snowy Owl.

Snowy Owl, adult male.

8

Comparing morphometric data of owls within the Barn Owl (*Tyto alba*) complex to illuminate taxonomic and phylogenetic relationships globally

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Barn owls occur in nearly every environment worldwide and inhabit every continent except Antarctica. Consequently, this wide distribution makes *Tyto* owls highly variable in morphology, and as a result has complicated the process of delineating their taxonomy. Multiple genetic studies have demonstrated that the Barn Owl complex has at least three genetically separate evolutionary units: the Western Barn Owl, *T. alba*, occurring from southern Scandinavia to South Africa; the American Barn Owl, *T. furcata*, from southern Canada to Patagonia; and the Eastern Barn Owl, *T. javanica*, from the Himalayan plateau to Tasmania. Despite the genetic evidence supporting the split of what was previously all considered *T. alba* into three species units, many ornithological groups like the American Ornithologists' Society continue to identify all Barn Owls as Common Barn Owls (*T. alba*), with numerous subspecies. One reason for the objection to the proposed split was the absence of non-genetic data (e.g., morphometric evidence) to confirm the genetic data. Morphological characteristics can be used to provide insight and evidence of evolutionary relationships. Clarifying the taxonomy of groups of organisms contributes to the conservation of species, since management and funding often rely on this information to assist with building conservation strategies. Consequently, this research conducted a comprehensive morphological survey of the proposed three Barn Owl species units and measured up to 21 different morphometrics on 261 live and 1271 museum Barn Owl specimens. Data analysis was conducted via PERMANOVA, Principal Component Analysis, and Random Forest Classification Modelling. All three species units were significantly different morphologically, with *T. furcata* being the largest and *T. alba* the smallest. These results support the genetic evidence of three species units in the Barn Owl complex. Additionally, based on ratio-converted data, the *T. javanica* unit had significantly different proportions than the *T. alba* and *T. furcata* units.

Key words: Barn Owl taxonomy, conservation, morphometrics.

9

Video assessment of an audio recorder to quantify Northern Saw-whet Owl (*Aegolius acadicus*) nesting behavior in southern Manitoba, Canada.

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Automated Recording Units (ARUs) such as the AudioMoth (Open Acoustic Devices) are relatively simple to operate and affordable and have been used to study animals based on the sounds they make. In spring 2021 we monitored a breeding pair of Northern Saw-whet Owls (*Aegolius acadicus*) using an Ubiquiti G3 Flex camera mounted in front of the nest and connected to a Raspberry Pi 4 computer to record video and sound to a portable solid-state drive (SSD). Concurrently, we placed an AudioMoth adjacent to the nest to record sound. Examining video files documented the behavioral context of sexual and chronological variation in auditory communication exchanges between individual owls, nest inspections, nest attentiveness, prey deliveries, and to a limited extent the identification of prey. AudioMoth sound files were subsequently analysed with Audacity (v 3.2.2.) and Kaleidoscope (v 5.5.0, Wildlife Acoustics) and compared with data tabulated from video files. The male uttered calls during each visit to the nest box, and the female and/or nestlings typically responded with food demand calls. As expected, prey delivery rates were lower during incubation, increased over the nestling period and decreased as nestlings fledged. The AudioMoth data slightly overestimated prey delivery rates as video data revealed that the male also vocalized when occasionally visiting the nest box without prey, especially during the incubation period. Video data also documented infrequent non-vocal prey deliveries by the female during the latter part of the nestling period. We conclude that the AudioMoth documented most prey deliveries and was useful for determining breeding chronology and nesting success. Low cost and easy to use ARUs could be deployed and maintained by trained volunteers or citizen scientists for widespread studies of nesting owls.

Key words: nesting behaviour, automated recording unit, vocal communication, diet, video monitoring.

10

Barred Owl (*Strix varia*) activity and diet recorded with a camera trap at a natural cavity nest in Manitoba, Canada

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Camera trap images (n = 27,092) collected at a natural Barred Owl (*Strix varia*) nest site in Manitoba, Canada, 2016–2019, were used to quantify nesting behaviour and identify prey delivered to the nest. Adult Barred Owl activity increased prior to egg laying and again after incubation. Adults were mostly active at night, but daytime activity increased during the nestling period in 2016 and more so with a larger brood in 2017. Nestlings were active at the nest entrance both day and night for 8–9 days prior to fledging at ≤ 27–32 d old. Two of three nestling activity peaks (0400 and 2000 Central Daylight Time or CDT) corresponded to prey delivery activity peaks whereas a third peak (1200 CDT) did not. Only 31 of 65 prey were identified to species, but 12 new prey taxa were documented for the Barred Owl in Manitoba. Activity at the cavity during the non-breeding season before and after a nest predation event were documented; the nest site was abandoned after a Black Bear (*Ursus americanus*) visited the nest cavity in May 2018. Factors affecting the quality and quantity of images, and hence data obtained from them, included camera position relative to the nest cavity entrance, light levels, camera trigger speed, non-target species, and the configuration and settings of motion detection sensors. Improved camera traps may overcome these limitations. This is the first study on this owl species using this increasingly popular technology.

Key words: Strix varia, nesting activity; prey provisioning; diet; camera trap.

Barred Owl.

11

Unraveling the evolutionary adaptations of the Snowy Owl (*Bubo scandiacus*) using a unique combination of population and comparative genomics

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The Snowy Owl (*Bubo scandiacus*) is an arctic species with a circumpolar distribution. This enigmatic

species is highly adapted to an arctic lifestyle. However, the genetic basis of this evolutionary adaptation is unknown. Given its recent population decline and susceptibility to negative effects of climate change, investigating the population structure, local distinctness and evolutionary potential is paramount. The Snowy Owls' dispersal throughout vast and remote areas makes field studies challenging, for this reason, genomics investigations can be instrumental in research and monitoring of this species. We have sequenced the genomes of 47 Snowy Owls, covering their geographical range, including Fennoscandia, Russia, Greenland and North America. Additionally we have sequenced a population from their sister species, Great Horned Owl *(Bubo virginianus)*. Using this population and comparative genomic data we will unravel the Snowy Owls population structure, demographic history and the genomic basis for evolutionary adaptations to an

arctic lifestyle. As an indicator species for the health of the Arctic ecosystems, these findings can yield implications beyond just conservation management of a single species.

Key words: evolution, population genomics, comparative genomics, adaptation.

12

Courtship observations and mating display of the Buff-fronted Owl (*Aegolius harrisii*) in southern Brazil

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The Buff-fronted Owl *(Aegolius harrisii)* is one of the Brazilian owls whose natural history is less known. This places it among the least known species in the Neotropical region. We provide new information on the courtship and copulatory display of *Aeglius harrisii* in the Brazilian Atlantic Forest. We adopted the ad libitum animal sampling method in this study. The first encounter was a random observation on 20 March 2020, in a flooded area of rain forest, in Teixeira Soares, Paraná State. Assuming the owls' activity would be repeated, a trail camera was installed on site and we began to visit the area daily at dusk. We assumed the sex of individuals based on what was described for *A. acadicus* and *A. funereus*. The owl that received the prey was considered the female and the donor was considered the male. In the first encounter, we observed that the male typically called (6-8s) at the beginning of twilight approximately 200 m from the nest cavity, and after some time, the male and female approached. The female remained perched and gave a vocalization similar to dependent fledglings. After attracting the female to its territory, the male showed the cavity by hovering for a few seconds and leaving food for the female inside the cavity. We witnessed this behavior on eight occasions, and we observed that after leaving the prey in the cavity, the male circled the nest area in flight issuing a characteristically prolonged call (11-12s). Then, he moved towards the boundary of the territory. The copulation took place under a new moon and was recorded by a trail camera (April 23) capturing short, repeated bouts, lasting only a few seconds. After copulation, the female moved into the cavity.

Key words: behavior, reproduction, Atlantic Forest, Strigiformes, nest cavity.

Boreal Owl, female in nesthole excavated by Black Woodpecker in pine, Norway.

13

Morphological variations between the Burrowing Owl (*Athene cunicularia*) subspecies from Brazil

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The Burrowing Owl (*Athene cunicularia*) is widely distributed in Brazil, with three subspecies described: *A. c. grallaria* for the eastern region, *A. c. cunicularia* in the south and *A. c. minor* in the north of the country. So far, no studies have been published identifying genetic, morphological and vocal variations between the subspecies. This work aimed to describe the possible morphological variations between the Burrowing Owl subspecies that occur in Brazil. A hundred-eight individuals were measured, with forty-five captured in four states: Minas Gerais, Paraná, Rio Grande do Sul and Roraima; and sixty-three measured from museum skins included to cover other parts of the country. Measurements of the tarsus, beak, wings, rictal bristles and plumage were collected and analyzed through a PCA analysis. Of the measured variables, wings, beak, minimum width of the tarsus and rictal bristle were the ones that most contributed to the variation in dimension 1 (50.8%), while the length of the tarsus contributed most to the variation in dimension 2 (14.3%). Of the thirteen regions sampled, the only one that proved to be a completely isolated group were individuals from Roraima and Amazonas (*A. c. minor*), except for a pair of owls, probably made up of two subspecies, *A. c. minor* and *A. c. grallaria*. Some groups clearly distinguished from the other samples, such as specimens from Bahia, and from Minas Gerais, Mato Grosso do Sul and Goiás, with morphological measurements distinct from the expected subspecies, being significantly smaller than *A.c. grallaria* and *A.c. cunicularia*, and larger than *A.c. minor*. Measurements of individuals (expected to be *A.c. grallaria*) collected in Espírito Santo, Paraná, Rio Grande do Sul, Maranhão, São Paulo and Mato Grosso have overlapped. Based on the morphological characteristics, we conclude that even sampling in regions where *A. c. cunicularia* was described, the subspecies was not found in our sample set, with mainly in *A. c. grallaria* and *A.c. minor* found, but with other possible variation in the subspecies in an isolated group. Whereas this group is morphologically smaller than *A.c. grallaria* and *A.c. cunicularia*, this could mean a morphological transition zone of *A.c. grallaria* for *A.c. minor*, also making it possible to raise the hypothesis of the occurrence of a possible new subspecies in Brazil yet to be confirmed with DNA analysis and bioacoustics.

Key words: review, taxonomy, Burrowing Owl, PCA, morphology.

14

Beyond vermin: Update of direct threats to non-breeding Short-eared Owls (*Asio flammeus*) in Iberia

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Short-eared Owls (SEOs; *Asio flammeus*) are considered a Species of European Conservation Concern, and recently an alarming decline in their population has been reported. Even though habitat loss seems to be the major factor behind this decline, it is important to access the direct threats affecting the species. In Spain, 83.9% of the mortality was caused by human activities or direct persecution, with, for example, road traffic collisions killing 8% of the SEOs. These factors were escalated by the public perception towards raptors shortly after the vermin control campaigns in Iberia during the 1940's through the 1960's, when raptors were actively persecuted. Thirty years after the Spanish assessment, we evaluate for the first time the direct threats to SEOs in Portugal and assess if the change of the public attitude in Iberia may have had repercussions on the mortality causes. We collected admission records from Portuguese wildlife rehabilitation centres and complemented them with public records from citizen science platforms. In total, 35 records of dead/injured SEOs were available, of which 18 with unknown causes. Of the known causes, the main threat was road traffic collision, immediately followed by entanglement in barbed wire, which was not identified as a problem in Spain. Three owls were shot, a much smaller portion compared to the Spanish assessment (70%), which was also seen in other raptors as a reflex of the reduced persecution. To reduce direct threats to raptors in Iberia, it is important to continue to raise the public perception about the benefits of these species, and reduce the impact of human activities, e.g., acting on hotspots of road mortality and reducing the use of barbed wire.

Key words: mortality, owls, persecution, threats, Iberia.

15

Structured citizen science to unravel the distribution of wintering Short-eared Owls (*Asio flammeus*) in Portugal

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Citizen science has proven to be very useful in ornithology, especially for data collection of the distribution of discrete raptors. Short-eared Owls (*Asio flammeus*) are present in Portugal during winter, where their reduced vocal activity, low density and crepuscular habits hamper detection. Nevertheless, the overall decline of its European populations emphasizes the importance of determining its distribution in Portugal, estimating the size of the wintering population, and establishing a baseline for future assessments. To accomplish this, we assigned regional coordinators to 20 areas, who were responsible for recruiting amateur observers across pre-selected priority areas. In December 2021 and January 2022, the participants conducted sampling points with playbacks at sunset, followed by car transects. This sampling effort totalled 400 h and resulted in the recording of 91-112 wintering Short-eared Owls in Portugal. The 178 volunteers allowed for extensive coverage of the priority areas. The results support the previously known relevance of areas such as the Tagus estuary, but raised some concern, especially about the Sado estuary, where this species was thought to be more abundant in the ’90s. The census also yielded the first record in the Castelo Branco area. The extensive coverage of suitable habitat areas for the species would likely be impossible without the involvement of so many volunteers, and this is of major importance in elucidating the distribution of discrete raptors. This shows that well-managed citizen science programs can play an important role in elucidating the distribution and addressing knowledge gaps about raptors, regardless of their cryptic habits.

Key words: citizen science, census, wintering, population size, Short-eared Owl.

16

Trophic niche of wintering Short-eared Owls (*Asio flammeus*) in Portugal

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In Europe, Short-eared Owls (*Asio flammeus*) are known to be specialist predators, with preferences for Common Voles (*Microtus agrestis*) and Short-tailed Voles (*Microtus arvalis*). However, these prey species are absent in the south of the Mediterranean region, which is an important wintering area for Short-eared Owls. Understanding the dietary variations of these owls is crucial, especially considering the pronounced decline they experience across their entire range. It is important to explore how their food choices change in the presence or absence of their preferred prey. Moreover, it is essential to know how their diet fluctuates throughout different seasons and in diverse habitats. To investigate this, we collected more than 400 pellets on six different winter roosts in Portugal. We observed major differences in Short-eared owls' winter diet, with Algerian Mouse (*Mus spretus*) representing 50% of its diet in one roost, whereas in another roost birds (mostly Waders *Charadriiformes spp.*) represented 52% of the owl's diet. Besides, when present, Common Voles made only up to 7% of the diet, perhaps due to their low local abundance. In addition, Short-eared Owls seemed to broaden their diet at the end of winter. In the future, it is important to assess if these differences reflect local prey abundances, different land use or individual specialization. This study, which represents the second-largest analysis of the owl's diet in the Mediterranean region, provides important insight into the variation within the winter season. Our findings highlight the significance of conducting a spatially widespread sampling across a wide timeframe to accurately capture the local and temporal fluctuations in the diet of Short-eared Owls.

Key words: diet, nomadic, wintering, raptor, small mammals, spatial variation, temporal variation.

Short-eared Owl, male with vole.

17

Wintering patch selection of nomadic owls: Short-eared Owl (*Asio flammeus*) area selection in Portugal.

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Habitat selection shapes an individual's fitness. In nomadic species such as the Short-eared Owls (*Asio flammeus*), the key areas are constantly changing, making it complex to understand the cues that allow them to select patches with greater prey abundance. In Portugal, this species is only present during the non-breeding season and has an Endangered threaten status. To understand what drives their distribution we used species niche modelling (SDM) to analyse what habitat and abiotic factors influence wintering area selection at a national scale. Next, we compared the local landscape composition, vegetation, and relative soil humidity of three roosts and hunting locations with adjacent areas where the species was absent. Short-eared Owls in Portugal prefer lower altitude areas with close freshwater sources, and neither temperature nor precipitation influenced their wintering distribution. The preference for lower elevations and the minimal impact of temperature, which contrast with factors guiding the species breeding distribution, provide new insights for conservation efforts in wintering areas, not just in Portugal but throughout the entire Mediterranean region.

Key words: area selection, habitat, nomadic, SDM, altitude.

Short-eared Owl.

18

Characterizing Barred Owl (*Strix varia*) diet at the invasion front in California and midwestern native ranges of the United States

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Invasive predators can have negative impacts on biological communities through top-down predation, but the ecological processes that shape the consumption of prey in novel communities are less understood. The “Enemy release hypothesis” and “Naïve prey hypothesis” are two explanations for why invasive species succeed in novel environments, and diets of invasive predators are expected to initially expand and contract throughout the invasion process. Furthermore, differing invader densities, and fluctuations in climactic and biogeographic conditions that shape prey community composition are all likely to influence prey availability and selection, but the relative importance of each of these factors has yet to be tested. Utilizing the range expansion of Barred Owls (*Strix varia*) to western North America, we used DNA metabarcoding on intestinal samples to determine diet composition and diversity. We present preliminary results on the diets of Barred Owls within the native range (n=18) and two invasive populations in northern California (n=124). We compare diet diversity within and between native and invasive ranges as defined by alpha and beta diversities. Within the invasive range, mammals were the most consumed vertebrate (frequency of occurrence= 65%) followed by amphibians (32%), birds (22%) and reptiles (19%). The Klamath Cascade population had higher alpha diversity than the Sierra Nevada population at the family level. Composition differed between Sierra Nevada and Klamath/Cascade populations with greater variation in the Sierra Nevada population. Barred Owls are generalist predators within the invasive range with the potential to impact a number of species.

Key words: invasion success, diet composition, enemy release hypothesis, naïve prey hypothesis, predation.

19

Genetics-based assessment of California Spotted Owl (*Strix occidentalis occidentalis*) demography in southern California

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Population structure and genetic variation in California Spotted Owls (CSO; *Strix occidentalis occidentalis*) have fluctuated throughout time due to historical climatic oscillations and recent anthropogenic changes. These recent changes, such as habitat loss and high severity wildfires, have resulted in declines in CSO and led to multiple petitions for CSO to be listed in the Endangered Species Act. A key uncertainty preventing the listing of CSO is its status in Southern California where the owl uses coniferous forests distributed across the Peninsular and Transverse Mountain Ranges which are surrounded by high-density urban areas and urban sprawl. In this study, we leveraged next-generation sequencing to obtain thousands of single nucleotide polymorphisms across seven mountain ranges to characterize the population structure and genetic diversity of CSO in Southern California over time. Our results support decades of field observations that indicate substantial declines in population size and isolation between populations. We found high inbreeding (F=0.306-0.523) between mountain ranges in Southern California and low genetic variation. Our analysis of population isolation suggests that CSO in the Sierra Pelona Mountains is isolated from the other populations studied. Our study supports that CSO in Southern California is at high risk of becoming functionally extinct without immediate steps to conserve these populations and restore their habitat.

Key words: population decline, inbreeding, genetic variation, ddRAD.

20

Home range, habitat use, diet, and dispersal of breeding captive-released and wild Burrowing Owls (*Athene cunicularia*) in Manitoba, Canada, 2010-2012

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Burrowing Owl (*Athene cunicularia*) populations have declined rapidly across western Canada in the last 60 years due to many factors. In 2010 a modified reintroduction program was implemented in Manitoba

to help recover this endangered species. Adult breeding males were marked with GPS dataloggers (Gypsy 4, Technosmart) to assess home range size and habitat use during the post-emergence and pre-fledging stage when young were 10-21 days old. Dataloggers were removed prior to owls dispersing. Mean home-range size for captive-released owls was 0.43 km^2 (n=3, range 0.25 - 0.54 km^2) and for wild owls was 0.42 km^2 (n=2, range 0.10 - 1.02 km^2). On average wild owls travelled farther from the nest (121.4 vs 95 m) but all concentrated their movements near the nest burrow and favoured roosts and perches (i.e., satellite burrow mounds and fence posts near ditches). Habitats frequently used by both groups of owls included grazed pasture dominated by mixed grass prairie and areas along roadways and ditches. Pellets were gathered at or within five meters of nest or roost burrows every 10-14 days and prey remains were identified. Captive-released owls had fewer vertebrate prey (12% of 727 prey items) in their pellets compared to wild owls (30% of 666 prey items), however vertebrate prey biomass percentages (93% vs. 98%, respectively) were less divergent. Ground beetles (Carabidae) were the most common invertebrate prey and the Olive-backed Pocket Mouse (*Perognathus fasciatus*) the most common vertebrate prey for both owl groups. Wild adult and juvenile Burrowing Owls dispersed earlier (before mid-September) than captive-released owls (after mid-September). Captive-released owls readily adapted to the wild and in many respects behaved like wild owls and were able to fledge and raise young that dispersed. We conclude that the captive-release program was successful, but the long-term survival and reproductive success of adults and their young remains unknown.

Key words: home range, habitat use, foraging, diet, and dispersal.

21

First confirmed depredation of Aeʻo (Hawaiian Stilt, *Himantopus mexicanus knudensi*) by Pueo (Hawaiian Short-eared Owl, *Asio flammeus sandwichensis*) in Hawaiʻi

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The Hawaiian Islands have a high rate of species endemism but also one of the highest rates of species loss and extinction. Introduced predators on island ecosystems have been identified as one of the most significant causes for the decline of native bird populations (e.g. seabirds, waterbirds, and forest birds). The control and removal of those predators is a key component of the active management strategy for the conservation and the recovery of native endangered species across the Hawaiian Archipelago. However, depredation by native predators on native prey species also takes place, causing serious conservation challenges, which must be factored into recovery models for targeted endangered species. Here, we present incidental observations showing Pueo (Hawaiian Short-eared Owl; *Asio flammeus sandwichensis*) depredating Aeʻo (Hawaiian Stilt; *Himantopus mexicanus knudensi*), an endangered subspecies of the Black-necked Stilt (*Himantopus mexicanus*). We describe three different events that provide evidence of Pueo depredating Aeʻo during the 2020 and 2021 Pueo and Aeʻo breeding seasons in a wetland area on the island of Oʻahu: (a) a two to three weeks old Aeʻo chick freshly caught by an adult Pueo; (b) the discovery of at least 11 adult/sub-adult Aeʻo carcasses and remains near an active Pueo nest; and (c) a game camera photo of an adult Pueo standing near an active Aeʻo nest. To our knowledge, these observations are the first published accounts of Pueo (and Short-eared Owls in general) depredating this waterbird subspecies and its continental counterpart. Further investigation is needed to determine potential impacts to the breeding success and overall survival of Aeʻo across the Hawaiian Archipelago when compounded with depredation by introduced, invasive predators.

Key words: Pueo, Hawaiian Short-eared Owl, Hawaiian Stilt, depredation, endangered species.

22

Movement Ecology and habitat use of Pueo (Hawaiian Short-eared Owl, *Asio flammeus sandwichensis*) in Hawaiʻi.

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Short-eared Owls (*Asio flammeus)* are a globally distributed species present on all continents except Australia and Antarctica, with populations found in all combinations of temperate, tropical, continental, and island systems. The Pueo (*Asio flammeus sandwichensis*) is an endemic subspecies of Short-eared Owl and is the only remaining native avian apex predator to reside across the whole Hawaiian Archipelago. Suspected population declines in recent decades have resulted in the state-listing of Pueo as *Endangered* on the island of Oʻahu and recent listing on the U.S. Fish and Wildlife Service's (USFWS) list of Birds of Conservation Concern. However, despite increasing concerns, this ground-nesting raptor remains understudied and basic information about their biology and ecology is limited, including its daily/annual movements. In 2021,

six Pueo were captured from April to June on O‘ahu, of which five (three females and two males) were tagged with GPS-VHF transmitters; this was the first time Pueo were tracked using this type of device. On average, Pueo were monitored for 134 ± 66 days and 631 ± 308 locations were collected per bird (total of 3156 locations, range: 129-977). Preliminary results showed considerable variation in terms of movement patterns, habitat use, and home ranges by individuals. Pueo frequently used “natural” habitats during daytime, in contrast to higher use of agricultural fields, managed grasslands or urban areas at night. Some birds exhibited localized movements (within 10 km), while others travelled longer distances (2-3 trips up to 45 km), including visits to other islands (Molokai‘i, 73 km away). Inter-island movements of Pueo were suspected but had not been documented using tracking devices. Our preliminary results represent a major step towards a better understanding of Pueo movement ecology, population size and dynamics, and important implications for the conservation of Pueo across the entire Hawaiian Archipelago.

Key words: Pueo, Hawaiian Short-eared Owl, movement ecology, island-endemic raptor.

23

Design of the urban and industrial gardens based on Ferruginous Pygmy-Owl (*Glaucidium brasilianum*) behavior at Costa Rica Central Valley

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The nesting period of the Ferruginous Pygmy-Owl (*Glaucidum brasilianum*) in the urban and industrial areas of Costa Rica Central Valley is during the dry season, beginning in November and extending until April. Over twelve breeding seasons across the owl’s nest observation was possible to identify their diet, and items used to feed their juveniles. This information allowed us to understand the importance of a management plan to support cavity-nesters and their prey around development and fragmented areas with an increased tourist development. Fifteen artificial cavities with video cameras were placed within a radius of 5 kilometers from Hotel Robleda garden and around the communities of La Guácima, Ciruelas, El Coyol. The prey on which owls feed was identified and then we established various mechanisms to adapt our garden and thus provide a space that favors not only these birds of prey but also protects the their prey species at the same time.

Key words: Ferruginous Pygmy-Owl, urban areas.

Collared Owlet, India.

24

Scops Owl (*Otus scops*) migration from Turkey, Slovenia, and Spain

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In 2018 and 2019, a total of 66 adult Scops Owls (*Otus scops*) were tagged with 2.5 g GPS units at their nest sites in Turkey, Spain, and Slovenia. The tags recorded about 300 daily fixes on the owls, typically covering their entire migrations and wintering sites far to the south (i.e., sub-Saharan Africa). Nineteen owls were recaptured in 2019 and 2020, including both males and females, and their migration routes determined. Owls from Spain wintered in Ghana; owls from Slovenia wintered in Nigeria; and owls from Turkey wintered in Ethiopia and Sudan. This is the first-ever detailed migration study of this owl. Owls flew directly over the Mediterranean, some over the Red Sea, and some spent eight days crossing the Sahara Desert. Owls moved fast and far, and had frequent stopover sites along their routes. Our findings document truly amazing migration data for a highly nocturnal, insect-eating forest owl weighing 80 g.

Key words: Otus scops, migration, wintering areas, GPS.

25

Nest-site selection, home range and resource use of Great Horned Owls (*Bubo virginianus*) in the mixed-grass prairie of Saskatchewan

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Since European settlement, the Great Horned Owl (*Bubo virginianus*) has steadily increased in abundance in the Canadian mixed-grass prairie, likely due to increased woody vegetation (e.g., planted trees and shrubs) and anthropogenic structures suitable for owl nesting, roosting, and hunting. The increase of Great Horned Owls in the mixed grassland region can put them in conflict with other wildlife conservation efforts. My objective is to assess the nocturnal habitat use and territory size of breeding Great Horned Owls in grassland, cropland and mixed landscapes in southwest Saskatchewan. In 2022, nine owls (Cropland n=4, Mixed n=2, and Grassland n=3) were tracked using high-resolution satellite telemetry, yielding over 130,000 locations

across the three landscape types. A subset of these locations (210 locations) were visited to determine perch and surrounding habitat characteristics. High-use areas were characterized by perches that were, on average, 4.7 m tall, 161 m from the nest and had greater vegetation height (mean 56 cm) compared to medium, low or no-use sites. Great Horned Owls had larger territory sizes in native grassland (15 km^2) compared to mixed (6 km^2) and cropland landscapes (4 km^2). My results provide insight into habitat use by a synanthropic predator that has been highly successful in an anthropogenic landscape.

Key words: anthropogenic predator, land use, foraging, satellite transmitters.

26

Acoustic niche differentiation of sympatric Mountain Scops Owl (*Otus spilocephalus*) and Collared Owlet (*Glaucidium brodiei*) in eastern Taiwan

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Acoustic niche hypothesis predicts in sympatry, species will avoid competition by singing at unique bandwidths, or pitches, at unique times. Mountain Scops Owl (*Otus spilocephalus*, MSO) and Collared Owlet (*Glaucidium brodiei*, CO) are two small-sized owls and are endemic subspecies in Taiwan. They both inhabit forests with similar calling frequencies. This study tested the acoustic niche differentiation of the two sympatric birds. Programmable automated audio recorders were used in the forest of Hualian, eastern Taiwan to record night soundscapes. The calls of the two species were extracted by Sound Identification and Labeling Intelligence for Creatures (SILIC). The results revealed significant differentiations in calling behaviors of MSO and CO at both temporal and spatial scales. The number of calls of the two species significantly differed among sites, forest types, months, and time periods. MSO mainly calls after dark, while CO mainly calls in the evening and at dawn. In addition, this study also found that MSO calls were more common in secondary forests, their calling intensity peaked in February and March. In contrast, CO calls were more common in forest plantations and peaked in May. The results confirm the acoustic niche hypothesis for sympatric species with similar call frequencies, MSO and CO adopt different calling strategies to reduce interference of calling.

Key words: automated audio recording, acoustic niche differentiation, Glaucidium brodiei, Otus spilocephalus.

27

Some breeding site fidelity in Snowy Owls (*Bubo scandiacus)* in Fennoscandia documented by genetic analyses

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Snowy Owls (*Bubo scandiacus*) were studied during three breeding seasons (2007-2015) in Fennoscandia, with 4 (2007), 53 (2011) and 51 (2015) nests recorded respectively. Moult feathers were collected from nests and surrounding vantage points, and blood samples were collected from some of the owlets and from adults captured for banding. A total of 22 adults were equipped with satellite transmitters. Genomic DNA was extracted from blood (n=23), moulted feathers (n=131) and one tissue sample (n=1, from a male carcass). A total of 150 DNA profiles were obtained from blood and tissue samples (n=24) and moult feathers (126 of 131). These DNA profiles represented 104 unique individuals (75 females, 29 males). Except for a male with back-pack transmitter, identified by photo in the second study year (2011), all other owls were re-identified by DNA. Two males breeding in 2007 were identified in the same breeding grounds in 2011. Of 37 individuals (23 females, 14 males) identified in 2011, four females were also encountered in 2015. These females nested 79-366 km from their former breeding site in 2011. However, in 2015 no Snowy Owls nested in the area where these females nested in 2011, probably due to lack of Norway Lemmings (*Lemmus lemmus*). Satellite tracking of the 22 adult owls showed that they flew to the Russian Arctic when lemming population crashed in Fennoscandia, venturing as far as almost 3500 km (measured across land areas) from their nesting sites in Norway. Compared with such dispersal distances, the reappearance of female owls on the Fennoscandian breeding grounds in 2015 could be considered philopatric, despite of recorded distances between nest places from 2011 to 2015. The two males reappearing in the same area in 2007 and 2011 were highly philopatric.

Key words: Snowy Owl, breeding-site fidelity, genetic analyses, satellite telemetry.

Photo: Tomas Aarvak

Satellite tagged male Snowy Owl "Yngvar", photographed from helicopter in 2011 on the same breeding grounds where he was marked in 2007, Norway.

28

Effects of passive relocation on urban Florida Burrowing Owls (*Athene cunicularia floridana*)

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The Florida Burrowing Owl (BUOW; *Athene cunicularia floridana*) historically inhabited Florida's dry prairie. However, most of the dry prairie has been converted to pasture and agricultural land, greatly reducing the BUOW's native habitat. Today the BUOW is listed as State-Threatened and distribution estimates suggest that most reside in rapidly developing, urban areas. With construction permits to displace urban BUOW's being issued at an unprecedented rate, it is imperative that conservation actions effectively mitigate any significant alteration of local habitat that could lead to adverse effects on the individual's essential behaviors, which could ultimately affect the population as a whole. We attached radio transmitters to 38 BUOWs in Cape Coral, FL using backpack-style harnesses. Across 27 sites, we tagged 19 owls on lots slated for development and 19 owls on lots where development was not expected within the near future. Owls were monitored through the non-breeding and breeding season season to determine post-displacement dispersal, survival, and productivity. A landscape analysis was conducted to determine how the surrounding environment affects relocation success.

Key words: Burrowing Owl, productivity, development, displacement, passive relocation.

Male Burrowing Owl showing aggressive display in front of nest entrance trap.

29

Results of a 15-year demographic study of Burrowing Owls (*Athene cunicularia*) in north-central Oregon, USA

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As of 2008, there were only 3-4 pairs of Western Burrowing Owls (*Athene cunicularia hypugaea*) left on the 6800 ha Umatilla Army Depot. This was the result of a misguided coyote (*Canis latrans*) control program aimed to benefit an introduced population of pronghorn (*Antilocapra americana*), but in the process had also eliminated American badgers (*Taxidea taxus*). The subsequent loss of burrows formerly created by the badgers left no places for the owls to breed and their numbers crashed. We installed artificial nest burrows designed to mimic badger burrows, and the number of owl pairs quickly responded with 9, 32, 61 and 65 nesting pairs in 2009, 2010, 2011, and 2012, respectively. We maintained 92 nesting sites (196 artificial burrows) from 2013-2022, during which an average of 53 pairs nested annually. Due to the ease of access into the artificial burrows, and advanced trapping methods, we were able to essentially capture and band all of the adults and young owls each year. Overall, we banded some 2800 individual owls during this study and tracked the outcomes of 608 nesting attempts. We were able to summarize data regarding clutch sizes, hatch dates, number of young reaching banding age, longevity and ageing, migration and dispersal, immigration and emigration, mate selection, mortality issues, key predators, migration to wintering sites, weather and vegetation, burrow design and specific aspects regarding productivity and maintenance, along with burrow siting, spacing and installation. We provide recommendations for land managers and others wanting to enhance or re-establish populations of burrowing owls in their regions.

Key words: demographics, artificial burrows, long-term study, Athene cunicularia, Oregon.

30

Advances in Burrowing Owl (*Athene cunicularia*) capture techniques

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Collectively, and humbly, we have captured several thousand Burrowing Owls in the last two decades. We have employed various trapping methods, and have captured resident and migrating owls during the breeding and non-breeding seasons. In this paper, we present an array of capture scenerios and methods for Burrowing Owls (*Athene cunicularia*) that we have employed. We provide data on capture rates, including the timing of capture (during day and night) for both during the nesting and non-breeding seasons. We offer insights into trap and bownet designs, into the use of mp3 players and speakers with territorial calls of a young male owl, and into the important nuances of trap placement and decoration. Playback recordings of territorial males need to be subspecies-specific. We have used playback of food-begging young to lure young owls into the traps from inside their burrows, as well as lure adults into the traps from outside the burrows. We have also used the playback of small mammal prey, the buzz/motion of solar-powered insects, and the predation threat of kites in the shape/color of falcons. Our experience indicates that it is possible to routinely capture all owls (adults and juveniles) in given study areas during the breeding season. Up to 77% of the adults can be captured during the first outing; another 22% during the second outing; and the last few during a subsequent outing. The key to effective trapping of Burrowing Owls comes from understanding the behavioral motivation of the trap situation, such as burrow defense, placement of decoration, hunger, immediacy of predator avoidance, winter burrow use, or family group dynamics.

Key words: Burrowing Owl, capture techniques, playback, trap design.

David Johnson with trap arrangement in Burrowing Owl nest entrance.

31

Updated Western Burrowing Owl (*Athene cunicularia hypugaea*) breeding distribution map in North America

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The Burrowing Owl (*Athene cunicularia*) is a small, ground-dwelling owl species inhabiting open, sparsely vegetated prairies, deserts, and grassland areas from the tip of South America into southern Canada. In North America, the Western Burrowing Owl (*A.c. hypugaea*) breeding distribution ranges from southern portions of western Canada through western conterminous United States, into central Mexico; a disjunct subspecies population occurs in Florida (*A.c. floridana*) but it is not addressed in this study. The Western Burrowing Owl is considered threatened or endangered in portions of its range due to habitat loss; declining populations of prairie dogs (genus *Cynomys*) and other species that create burrows used by the owl for nesting; secondary poisoning; accidental mortality; and climate change. Accurate and timely maps of its breeding range and areas of greatest conservation value are required for conservation planning, but existing maps exhibit deficiencies related to thematic, spatial, and temporal GIS resolutions. For the Western Burrowing Owl, as for many species, general range maps portray nearly all potentially occupied habitat (low omission error), but consequently include substantially large geographic extents of unsuitable area (high commission error). Furthermore, the Western Burrowing Owl is experiencing a decreasing population and shrinking geographic distribution that differs from historical range maps. We analyzed range maps, spatial distribution models, and breeding location records for this species, then incorporated geospatial datasets that represent suitable land cover (grassland/herbaceous) and habitat constraints (elevation, slope, and tree cover) for refining maps of its breeding range. We discuss impacts of scales of analysis on resulting range map delineations. Finally, we offer a final map of the Western Burrowing Owl for the time period 2013-2022, based upon nest records, breeding season observations, banding data, geospatial datasets, and final peer review. The final map will be made available as a shapefile and published on various platforms.

Key words: Burrowing Owl, range map, breeding range, geospatial datasets, land cover.

Burrowing Owl, Umatilla, Oregon.

32

Effects of land use and artificial light (streetlights) on the nesting distribution of Burrowing Owls (*Athene cunicularia floridana*) in Cape Coral, Florida, USA

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Cape Coral is a city in southwestern Florida well-known for its numbers of threatened, resident Florida Burrowing Owls (*Athene cunicularia floridana*). Using the exact locations of 454 nests with young in June 2020, 704 random points, and the inventory of 19,554 streetlights, we examined the distribution of nesting Burrowing Owls given land-use and "light-scape" analyses. We examined four ever-finer spatial-scaled hypotheses: H_1) grassland patches are the primary driver of owl locations, with streetlights being secondary modifiers thereafter; H_2) streetlights (of any kind) have a negative effect on the distance to owl nests; H_3) the distance from streetlights to owl nests depends on the brightness (lumens) of the streetlight fixture; and H_4) the distance from streetlights to owl nests depends on the frequency (nm and Color Corrected Temperature – CCT) of light given off by the streetlight fixture. Under all hypotheses, random points were considered indifferent to distances to land-use patches or locations or types of streetlights. Under H_1, there were five land-use types: grassland, lawn, impervious surface, roadway and forest. The 704 random points were located in: grassland (27.1%), lawn (24.1%), impervious (29.8%), forest (11.4%), and roadway (7.8%). The 454 nest points were located in: grassland (78.9%), lawn (20.4%), impervious (0.7%), and no nests in roadway or forest. Our results show 99.3% of owl nests were found in grassland and lawn locations, while only 41.2% of the random points were ($p < 0.01$). Under H_2, we measured the distances from owl sites and random points to the nearest streetlights, with no consideration given to the light fixture type or light therefrom. We also found that the average distance (min-max) from nest sites to streetlights was 49.7 m (3.9 - 166.2 m). The average distance from random points to streetlights was 62.7 m (0.7-280.1). Under H_3, there were 8 different types of streetlight fixtures: 100 watt (w) High-Pressure Sodium (HPS), 100 w LED (Light-Emitting Diode), 150 w HPS, 250 w HPS, 400 HPS, 400 w Metal Halide (MH), 400 w LED, and 1000 w MH. Light from each of these types ranged from 9,500 to 110,000 lumens. Under H_4, we examined the nm frequency and CCT of each of the light types, and their respective distances to owl sites and random points. The light frequencies ranged from 1900 K to 5000 K. Overall, we found that owls are distributed by the availability of grassland areas and by light intensity.

Key words: urban, Florida Burrowing Owls, artificial light, nests, streetlights.

33
Ecomorphology and niche differentiation among North American and European owls

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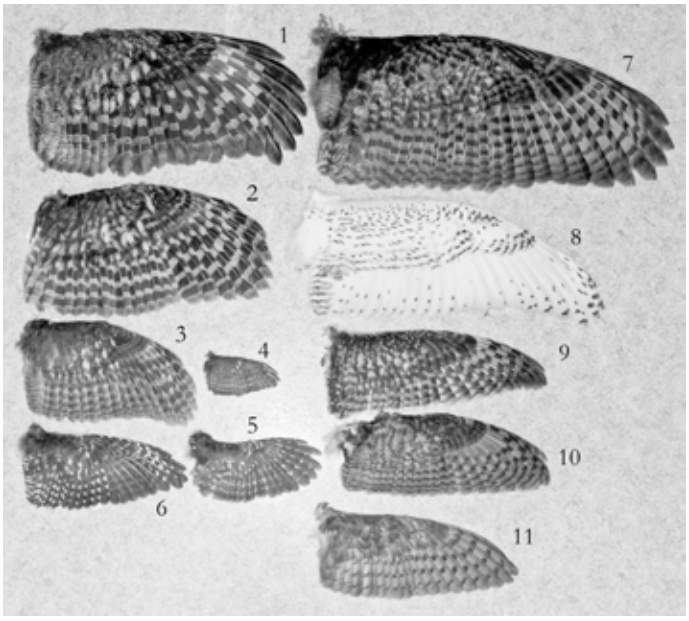
Among owls, some anatomical characteristics, such as ear size, shinbone length, wing shape, and size of the breastbone show considerable variation, which remains after correction for variation in body size. In order to explain this variation among European owls we have drawn up hypotheses relating morphological traits to variation in animal behaviour and ecological conditions of the typical habitats in which the species occur. We expect these relationships to be equally applicable to North-American species, and to test this assumption we will perform dissections on North-American owl species right before and during the World Owl Conference. On the final day of the conference we can give an overview of functional-anatomical variation among and North-American owl species in relationship with their behaviour and habitats, and reveal which different trait-ecology combinations exist on both continents, which we shall further discuss. We hypothesised for European species that 1) exclusively nocturnal species and species that hunt in dense and tall vegetation have well-developed external hearing adaptations, 2) species that require force to catch or carry their prey have long shinbones (allowing larger muscles), 3) species that rely on strong flight for migration or on carrying large prey have a higher breastbone keel, and 4) species with a small home range or that live in forested habitats have rounded wings (low aspect ratio). Besides the features related to these hypotheses we will make further morphological comparisons between the European and North American owls. The genera of species from both continents greatly overlap, which allows within-genus comparisons as well as between genera. The latter may in particular reveal examples of analogous evolution of traits and niches among owls.

Key words: ecomorphology, niche differentiation, European owls, North-American owls.



Wings of 1: Great Grey Owl, 2: Ural Owl, 3: Tawny Owl, 4: Pygmy Owl, 5: Boreal Owl, 6: Hawk Owl, 7: Eagle Owl, 8: Snowy Owl, 9: Short-eared Owl, 10: Long -eared Owl, 11: Barn Owl.

34

How the Tawny Owl (*Strix aluco*) survives in a changing landscape: a 63-year study of raptor populations in The Netherlands

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Stable, undisturbed ecosystems are rare in Europe. Pollution, fragmentation of the landscape, land use, nature protection and other human activities often affect the composition of flora and fauna. Nature conservationists and politicians often decide which type of landscape should be protected and those decisions change over the course of time. In our study area, the Amsterdamse Waterleidingduinen, natural succession is often stopped in order to protect a more dynamic landscape. The protection of one species often has a negative impact on other species. In this long-term study we attempt to show how the Tawny Owl (*Strix aluco*) tries to survive under ever-changing conditions. Tawny Owls appeared in 1961 in the study area, and over the course of 63 years, we documented the colonization of two species of birds of prey and two species of mammalian predators. This resulted in the disappearance of certain species and constant changes in prey composition, breeding results, and distribution of the owls and hawks in the study area. Control measures for invasive plant species and the introduction of fallow deer (*Dama dama*) had an enormous impact on the ecosystem.

Key words: Tawny Owl, Strix aluco, raptor interrelations, changing landscapes, conservation impacts.

Tawny Owl being eaten by young Goshawk, Grimstad, Norway, 12. March 2006.

35

Habitat preferences and survival rates of Short-eared Owls (*Asio flammeus*) in natural refuge habitats of Central Europe

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The Short-eared Owl (*Asio flammeus*) is a ground-nesting species of open grasslands. Throughout Europe, it has experienced severe population declines in recent decades. Here, we studied habitat and nest-site preferences as well as nest and fledgling survival of the species in relation to (i) habitat composition, (ii) vegetation structure, (iii) weather conditions and (iv) vole abundance. The studies were conducted in natural dunes on the East Frisian Island of Spiekeroog (southern North Sea, Germany), which harbours one of the last remaining permanent populations in Central Europe. Dune grassland was the main breeding habitat of the Short-eared Owl in the study area. Within these gasslands it preferred tall and dense vegetation for nest building that was surrounded by foraging habitats exhibiting a vegetation of intermediate height. Moreover, litter was a crucial component of the habitats, which might be important for reasons of concealment.
Our studies showed that particularly strong winds affected the survival of the fledglings. Probably windy periods led to a reduced hunting success of the adults and increased food demands of the juveniles for thermoregulation. This indicates that an increasing frequency of extreme weather events, as expected with ongoing climate change, may decrease the breeding success of the Short-eared Owl. The preference for tall and dense vegetation rich in litter for breeding can also be interpreted as an adaption to reduce energetic costs during periods of adverse weather. Additionally, voles also preferred vegetation having a pronounced litter layer. In conclusion, tall grassland vegetation rich in litter seems to be of prime importance for breeding Short-eared Owls. Such habitats (i) provide shelter from predators, (ii) reduce the risk of cooling during periods of unfavourable weather and (iii) favor high prey abundance. Suitable grassland habitats might be created through low-intensity land use by applying agri-environmental schemes that encompass rotating fallows.

Key words: breeding success, dune grassland, nest survival, vole abundance, weather condition.

36

A photographic guide to aging Snowy Owl (*Bubo scandiacus*) chicks from hatching to fledging in Utqiaġvik, Alaska

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The ability to age nestlings accurately is important in studies on reproduction and development in owls. Aging young can clarify hatching dates and help track developmental chronology and survival. Snowy owls provide a unique opportunity to document development due to their ground nests and resiliency to researcher presence. The Owl Research Institute published mass growth rates and comprehensive descriptions of 8 stages of development in Snowy Owl (*Bubo scandiacus*) nestlings in Utqiaġvik, Alaska in 2016 using data and observations from 225 nestlings. Here, we supplement these findings with observations and photographs from a nest in 2022 to create a photographic and descriptive guide to aging pre-fledging Snowy Owls. We delineate 7 developmental stages, from pipping in the egg to 41 days old. Developmental variables described and pictured include flight and downy feather plumage, cere, eyes, feet, vocalizations, and behavior. Photos and descriptions of age-specific behaviors and morphological changes create a comprehensive and easy-to-understand guide to development and aging in owls. This guide is meant to aid researchers in the field as well as add to the pictorial documentation of this declining species.

Key words: Snowy Owl, growth rate, aging, development, photographic guide.

Snowy Owl nestling at Fennoscandian mountain tundra nestsite.

37

Environmental contaminants in a top Arctic predator: a decadal monitoring of Snowy Owl (*Bubo scandiacus*) health

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Since the winter of 2013-14, the veterinary and pathology team from Project SNOWstorm (www.projectsnowstorm.org) and its partners have necropsied more than 450 salvaged Snowy Owls from across North America. This amounts to the world's largest dataset on Snowy Owl health, disease, and exposure to environmental contaminants. Such a repository allows the investigation of a variety of aspects of mortality, health, and disease, including environmental toxicants such as methylmercury, lead, pesticides, and rodenticides. Here we present the results of the first large-scale analysis of environmental contaminants in this at-risk species, including differences across age and sex classes, and across regions over time. Quantifiable amounts of three anticoagulant rodenticides were detected in 28% of 109 specimens screened, with 10 individuals showing brodifacoum levels over the 0.03 ppm associated with potential mortality. Organic chemicals including DDE and PCBs were detected in 56% of owls for which results were available, while 41% showed levels greater than trace levels. Two owls also chowed reduced brain cholinesterase levels consistent with organophosphorous insecticide poisoning. Liver lead screening results were available for 142 owls, out of which 11% (n=15) showed low but quantifiable levels. Quantifiable levels of liver mercury were seen in 58% of 122 screened owls, and 25% showed liver mercury concentrations above the threshold associated with adverse effect on reproduction. In contrast to their remote breeding across the Arctic, many Snowy Owls rely heavily on high human density areas in the winter, exposing them to a variety of contaminants from rural and urban sources. Such exposure may add to the increasing pressure faced by this declining predator when nesting in the tundra, a biome where climate warming is the fastest and the strongest. Overall, these results are a first step toward linking environmental contaminant exposure to Snowy Owl population dynamics, a key aspect to understand their sensitivity to anthropogenic pressures.

Key words: Snowy Owl, Bubo scandiacus, environmental contaminants, mortality, necropsy.

38

Differential timing of migration in Northern Saw-whet Owls (*Aegolius acadicus*) in central Wisconsin based on age and sex categories

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The Northern Saw-whet Owl (*Aegolius acadius*; hereafter NSWO) is one of the smallest owls in North America. It is found as far north as central Canada and Alaska and migrates as far south as central Mexico. The annual fall movements of NSWOs are highly variable across regions, age, and sex, as well as the number of owls migrating. Regional banding studies have reported preliminary evidence of sex-specific migration patterns in NSWOs, but little is known about age and sex-based migration patterns in this cryptic species. Previous sex-related studies show that sex does influence migration timing in certain harriers and hawks, as adult birds of prey attempted to remain on breeding territories for as long as possible thus delaying fall migration. The purpose of this study was to determine whether NSWOs followed a similar combination of age-sex migration patterns as other nocturnal birds of prey. From 2007 to 2022, NSWOs were studied at Sandhill Wildlife Area, a 9,000-acre wildlife refuge in Babcock, WI, operated by the Wisconsin Department of Natural Resources. We have captured over 1,300 NSWOs at Sandhill over the course of our study. NSWOs are captured using call-playback devices and mist-nets, then banded. Wing and tail chords, weight, age, and sex of birds are recorded with each capture. Migration date, defined as date of first capture, was standardized to a Julian date so that all years could be analyzed with the same test. The mean migration date was compared between age and sex groups using a 2-sample independent t-test (α=0.05). The same test was performed for all hatch-year (HY) birds versus all after-hatch-year (AHY) birds and all females versus all males. Our data showed that AHY birds migrated approximately 1.28 days earlier than HY birds, while female birds migrated later than males by approximately 2.22 days.

Key words: Northern Saw-whet Owl, sex-specific migration, Julian date, age, demographics.

39

Review and lessons learned over 40 years of captive bred reintroduction of the Western Burrowing Owl (*Athene cunicularia hypugaea*) in the grasslands of British Columbia, 1983-2023

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The Western Burrowing Owl, *Athene cunicularia hypugaea,* is a species at risk in Canada and was extirpated from British Columbia (BC) in the 1980s. To reestablish a population in BC a group of volunteers, which later became the Burrowing Owl Conservation Society of British Columbia (BOCSBC), instituted a re-introduction program involving three captive breeding facilities, the creation of artificial nesting burrows, and the release and monitoring of captive-raised birds annually since 1990. Approximately 100 owls are bred each year for release in the grasslands of the Thompson-Nicola and South Okanagan of BC. Over 800 burrows have been placed on privately owned ranch lands, provincial land, and non-government conservation properties. Release techniques have been developed that have increased adult survival rates by 50% and produced increased numbers of wild-hatched offspring to fledging by 50%. Increased production has resulted in an increase in the number of birds returning to nest from 2015 to 2017, resulting in a 50% increase from previous years. However, the goal of achieving a self-sustaining population has not yet been reached, as the population crashed again after 2018. By delving into our return rate, habitat quality, migration, climate change and more we can start to investigate further steps needed for BUOW repopulation throughout North America.

Key words: reintroduction, breeding, migration, BUOW.

Burrowing Owl, Umatilla, Oregon.

40

Methods for documenting nest failure in Short-eared Owls (*Asio flammeus*) in western Montana using novel nest cameras

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Short-eared Owl (*Asio flammeus*) populations have been declining over the past 60 years. In the Mission Valley of western Montana, nesting failure rates of nearly 90% have been seen in recent years and may be limiting reproductive output. Short-eared Owls nest on the ground in open-country habitats, making them very vulnerable to predators. To determine the causes of nesting failure, we developed a system of motion activated camera traps to record events at nest sites. Obstacles such as tall grass habitat, harsh weather, avian predators, and human error were encountered and minimized after two trial field seasons. Here we present the methods developed for setting successful camera traps on ground nesting grassland birds, and some remarkable footage obtained in the process. Preliminary results show that coyotes are a major nest predator and reveal that Short-eared Owls are sensitive to nest disturbance in the early stages of egg laying. Rarely seen behaviors such as prey deliveries and feeding of young were documented with video as well. Preliminary data lead to the conclusions that habitat fragmentation and management techniques need to be considered in order to increase the reproductive productivity of grassland owls.

Key words: camera trap, nest failure, predation, grassland bird.

Short-eared Owl, female with nestlings.

41

Alternation in the use of a dead tree hollow by two species of owls in an urban area in Brazil

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Brazil has 26 species of owls described for its territory, with some occurring in urban areas. Urban populations of owls and other birds can be easily found near residential areas due to the offer of shelter and food. This work aimed to describe the alternation in the use of the same reproductive structure by two species of owls in an urban area at the state of Rio de Janeiro, Brazil. The structure is the hollow of a dead coconut tree (*Cocos nucifera*), located in a residential condominium. The monitoring was carried out between June 2021 and February 2023, with a series of six daily observations of 30 minutes each, between morning and night. Two species inhabiting the same coconut tree hollow at different times were identified: the Ferruginous Pygmy-Owl (*Glaucidium brasilianum*) and the Tropical Screech-Owl (*Megascops choliba*). In June 2021, the male *G. brasilianum* began to inhabit the hollow and paired with a female in July. The first nestling was spotted in September, and later, two more young hatched, the last one in October of the same year. The adults were seen carrying small lizards, birds and rodents to the nest. After the *G. brasilianum* family left the hollow in December 2021, a male *M. choliba* was registered at the site and began to occupy the hollow in July 2022. The male remained solitary for a few months, until the female was registered in November. In January 2023, the birth of two young *M. choliba* was recorded in the same hollow used by *G. brasilianum* in the previous year. In February 2023, the tree was cut down by residents of the condominium, with no new records of both the species in the area since then. The study shows the importance of habitat structure for the reproduction of small-sized owls.

Key words: behavior, ecology, reproduction, urbanization.

Eurasian Pygmy Owl peeping out of nesthole.

42

Reproductive ecology of urban Burrowing Owls (*Athene cunicularia*) in Paraná, Brazil

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Burrowing Owls are common throughout much of the Brazilian territory and occur in many urban settings. However, there are few studies that have analyzed the status of urban populations in the country. This study examined the relationship between the degree of urbanization and the productivity of Burrowing Owl nests in the state of Paraná. Sixty-two owl nests were monitored from June 2022 through April 2023. We had the collaboration of citizen scientists to help us locate and monitor some of the owl nests. The nests were classified into three categories: low, medium, or high degree of urbanization. The number of chicks per nest that reached six weeks old and the number of neighboring Burrowing Owl nests within a radius of 250 m were counted. All data was analyzed through ANOVA tests. Of the 62 monitored nests, 44 were reported by citizen scientists and 18 were found through active searches. A total of 35 nests (56.4%) were successful in fledging and dispersing at least one nestling, while 27 nests (43.6%) failed. The nests fit mainly in environments with a medium degree of urbanization. The number of hatchlings per nest did not differ significantly among categories ($p = 0.66$), however, nests without the presence of neighboring nests showed a significantly ($p < 0.0001$) greater number of chicks than nests with neighbors. We registered the death of four individuals (3 young and 1 adult). Burrowing Owls face difficulties that interfere with the well-being and density of their populations, mainly because of the loss of suitable nesting areas and the consequences of contact with humans.

Key words: urbanization, urban density, nests, citizen science, impacts, reproduction.

43

Insect prey diversity, biomass, and parental foraging efforts in Flammulated Owls (*Psiloscops flammeolus*) of northern Utah

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Collecting data on foraging efforts and prey types in nocturnal birds presents various technological challenges. With increasing environmental and climatic pressures on insectivorous migrants, understanding the requirements for feeding their offspring may become crucial in managing and mitigating breeding habitats. Recent advancements of camera and data storage technologies have allowed for the recording of detailed nest activities and frequencies of parental provisioning during critical nestling periods. As part of a long-term study in northern Utah, we deployed modified camera systems in active nest boxes occupied by Flammulated Owls (*Psiloscops flammeolus*) during most of the nestling period over multiple years. Among nests, the proportion of identifiable prey items ranged from 0.547 to 0.695. Most of the prey types delivered to nestlings were nocturnal lepidopterans (moths; proportions from 0.300 to 0.627) with unspecified insect larvae and orthopterans (grasshoppers and crickets) alternately ranking as second most delivered types. Biomass delivered per nestling was significantly higher in nests with more successful fledglings ($P<0.05$). Female foraging efforts started increasing (reaching at least 5%) from seven to twelve days since the hatching of the first egg, later matching or exceeding the rates of the male. In several instances females seemed to deliver larger prey items to the nests compared to their mates. Nest territories with fewer abundant invertebrates showed higher frequencies of vertebrate prey supplementing nest provisions. The ability to accommodate the young in increasingly variable habitats will be crucial for the long-term success of natural avian populations.

Key words: parental investment, insect prey, foraging.

44

Flammulated Owl (*Psiloscops flammeolus*) occupancy, detectability, and forest use during the breeding season in the western United States

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The Flammulated Owl (*Psiloscops flammeolus*) is a small insectivorous owl occupying forests in western North America during the spring and summer breeding season. The species has not been extensively studied but is considered sensitive or at risk by many states and provinces in the region, and by forest management agencies. We implemented a broad survey program across multiple western states to assess its abundance, distribution, and habitat associations. We completed surveys at 3491 points, with one to three visits each. We detected flammulated owls at 289 survey points. We used occupancy modeling to account for imperfect detection in estimates of habitat associations. We found Flammulated Owls disproportionately used aspen habitats and used pine forests less than their availability. Douglas-fir forest had a neutral effect suggesting that it was used in proportion to its availability, although this could have been confounded by our strata selection. We found most Flammulated Owls at mid-elevations, on warmer slopes, with more solar radiation. We suggest that maps of range and distribution for the species be updated to reflect our findings, which may impact planning for forest management in some areas. Furthermore, management actions to promote aspen restoration and regeneration may help this sensitive species deal with the impacts of climate change.

Key words: forest composition, occupancy modeling, Psiloscops flammeolus, range, sensitive species.

45

Temporal and spatial population dynamics of the nomadic Short-eared Owl (*Asio flammeus*) across the western United States

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The Short-eared Owl (*Asio flammeus*) is a species of conservation concern in the western United States, and populations are declining throughout its range. Because of its low site fidelity, nomadic lifestyle, and irruptive breeding dynamics across large landscapes, estimating trends at regional or broader scales is difficult. To address that challenge, we recruited community-science participants to implement a multi-year survey of short-eared owls across a study area encompassing eight western states: California, Idaho, Montana, Nevada, Oregon, Utah, Washington, and Wyoming. We stratified our study area by potential habitat, established 50 spatially balanced transects per state, each with 8–11 survey points, and visited each transect twice per year to perform a 5-minute point count. From 2018–2020, transect occupancy rates of Short-eared Owls were highly variable within individual states but reasonably stable over our study area. California, Idaho, Utah, and Washington were the only states where occupancy rates were stable year to year, with the most stability in Utah and Washington. More monitoring may be warranted to address spatial and temporal variability in abundance of this species that may be influenced by small-mammal cycles. Our results illustrate the large movements of individuals across regions that may be required to support the North American population, emphasizing the need for broad geographic monitoring and conservation strategies for Short-eared Owls.

Key words: community science, grassland, marshland, nomadism, occupancy modeling.

46

Safe and ethical distances when using blinds for filming/photography of nesting Burrowing Owls

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From 2016 through 2023, we examined differing types of photography blinds near 21 active Western Burrowing Owl (*Athene cunicularia hypugaea*) nests in Oregon, Montana, and Arizona. We recorded owl behavior and acclimation periods to various blind types (e.g., plywood, fabric) and distances from nests. Distances from the blinds to the tunnel entrances ranged from 11.6 to 32.0 m. A fundamental aspect is that the blind must not block the clear view of the surrounding landscape for owls. Such blockage allows aerial- and ground-based predators to sneak up and attack before the owls can respond, putting the adult or juvenile owls at great (and unnecessary) risk. We make the following recommendations: 1) blinds must not be placed any closer than 16.8 m (55 feet) to the nest entrance, and preferably 18.3 m (60 feet) away; 2) the viewing port of the blind (i.e., lens height) is best when at the elevation of the tunnel entrance; 3) provide the owls 4 days of acclimation period before you use the blinds on a daily basis; 4) park your vehicle ≥200 m away from the blind, and best if it is parked completely out of sight; 5) observers should stay in the blind; moving around outside of the blind will only flush the owls and cause them to stay away for longer periods of time; 6) a mesh over the lens portal will help greatly in keeping the owls from seeing your eyes, and seeing you move inside the blind; wearing sunglasses (to hide your eyes) works; 7) ensure security of your blind; it is very windy in Burrowing Owl habitats, so anchor your blind so it does not flap or blow away; 8) do not make much, if any, noise once inside the blind; take snacks and drinks with you, and have a plan for dealing with potty calls.

Key words: filming/photography blinds, distances, ethics, best practices, Athene cunicularia.

Burrowing Owl, Umatilla, Oregon.

47

Short-eared Owl (*Asio flammeus*) conservation status in Manitoba, Canada

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Short-eared Owl (*Asio flammeus*) was listed as Threatened in Manitoba in 2012, due to long-term population declines in Canada based on Breeding Bird Surveys (BBS). In 2021 it was designated as Threatened in Canada (previously Special Concern) based on an estimated decline of around 30% over three generations using BBS data combined with information from other sources. An assessment in Manitoba using only provincial information is hampered by low detection rates on provincial BBS routes and consequent small sample sizes. Short-eared Owls occupy a large geographic range in Manitoba. However, the species was only detected in 86 squares during the first Manitoba Breeding Bird Atlas (BBA, 2010-2014). The BBA demonstrated that the species was most likely to be encountered in tundra habitats in northern Manitoba and in prairie wetlands, grassland, and marginal farmland of southern Manitoba, but was seemingly absent from most of the boreal forest. There were also tantalising observations of birds in large wetland complexes within the boreal forest. Although the BBA provided useful information relating to the species breeding distribution in Manitoba, on its own it does not provide enough data to satisfy the needs of a status assessment. We use data from multiple sources to determine whether an assessment of current conservation status can be made under the provincial *Endangered Species and Ecosystems Act.* Our findings suggest that although there is some information available, to establish conservation status we require a reliable source of trend information which is currently lacking, primarily because the species' crepuscular activity does not conform with BBS or nocturnal owl survey protocols. We discuss whether a survey designed specifically to monitor for Short-eared Owl is feasible in Manitoba and what it might look like.

Key words: Short-eared Owl, conservation, status, Manitoba.

48

Oklahoma's secret bird: The Northern Saw-whet Owl (*Aegolius acadicus*)

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Northern Saw-whet Owl (*Aegolius acadicus*) territorial males often stay on site throughout the winter. However, many females and hatch-year males move south during that time, perhaps for warmer temperatures and less intraspecies competition for food. Little is known about the migratory routes of these owls. Up until recently these they were rarely documented wintering below approximately 40° North. In November of 2016 researchers in northeastern Oklahoma began a systematic mist-netting/banding project to determine whether or not NWSOs were regular migrants/winter residents. Prior to the 2016 research there were only 15 records of Saw-whet in Oklahoma, and all encounters were considered rare, or listed as a straggler for the state. We captured and banded 20 individuals and recaptured three previously banded Northern Saw-whet Owls that year. Since 2016 sixty-one additional Saw-whets have been banded, along with five foreign recaptures. We now know there are Northern Saw-whet Owls are migrating through and also wintering in Oklahoma. Now that we understand this aspect of the owl's movements, we want to learn where they are migrating from, and this offers an opportunity to learn more about their migration routes. In 2022, five Northern Saw-whet Owls were banded in Oklahoma, and one was fitted with a Lotek transmitter in association with the Motus network due to technical issues. In the future, I propose to monitor where these elusive owls are migrating. By fitting the Northern Saw-whet Owls captured in Oklahoma with transmitters, I hope to get a closer look at the exact locations and direct movements of these owls.

Key words: Aegolius acadicus, migration, Northern Saw-whet Owl, telemetry, Motus.

Boreal Owl, female and chick in nestbox.

49

What do U.S. birders know about bird conservation needs?

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There is a serious disconnect between birder interests, the needs for bird conservation, and public policies for bird conservation in the U.S. An estimated 45 million Americans feed and/or watch birds. At the same time, 233 species of birds (22% of all native species) need conservation action. All regularly occurring species of owls in the U.S., except the Western Screech-Owl, are listed as a Species of Greatest Conservation Need by one or more states. This qualifies the species for funding under a variety of public-private programs, including State Wildlife Grants, the Neotropical Migratory Bird Conservation Act, Migratory Bird Joint Ventures, and operational funding by state wildlife agencies and federal natural resource agencies. Unfortunately, all of these sources are chronically underfunded. To better respond to evolving public values and bird conservation needs, it is necessary to gain an understanding of the values, motivations, and behaviors of birders. A survey of 5502 birders across the U.S. revealed that, 1) 42% of respondents scored bird conservation second only to acquiring more skills in identification among their top priorities, 2) < 5% were members of major ornithological societies, 3) females were more interested in bird conservation than males, 4) all age groups would like to get more information about bird conservation, 5) birders tend strongly liberal, 6) early childhood experiences were scored as important but were not predictive of adult behaviors, 7) 30-40% of respondents were not familiar with bird conservation initiatives, such as the North American Waterfowl Management Plan, and 8) bird conservation messages from conservation organizations were much more effective than those from public agencies in causing conservation behaviors. There is a huge opportunity for bird conservation advocates and initiatives to increase communication directly to birders. Better public policies and increased funding can result.

Keywords: birders, bird conservation, conservation information.

Boreal Owl, being released after capture and banding, Norway.

50

Provisioning rates and prey composition of a declining predator, the Little Owl (*Athene noctua*), in contrasting European farmlands

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The Little Owl (*Athene noctua*) is a small and sedentary raptor associated with agricultural landscapes. Though widely distributed, it is rapidly declining in Central and Western Europe. The key factor of its population decline may be linked with food limitation during the breeding season, which results in reduced reproductive success. However, it remains poorly understood how diet composition and/or provisioning rate during the breeding season is related to different nestling stages, weather conditions and habitat quality in contrasting farmlands. To fill this gap, we studied prey composition and provisioning rates of breeding Little Owls in different European countries (Czech Republic, Netherlands, Slovakia and Germany) using nest boxes with cameras. From 50,291 provisioned prey items identified from 57 broods across our study sites, we identified mammals to form the highest proportion (37%) of prey biomass delivered to nestlings, followed by earthworms (28%). Mammals also formed highest proportion during first ten days after hatching (48% of biomass). Insect provisioning peaked during 11-20 days after hatching (30% of biomass) and earthworms after 20 days of hatching (44% of biomass). Generalised Linear Mixed Effects Models indicated that provisioning rate increased with higher temperatures but reduced under rainy and humid conditions. High-quality foraging habitats (grasslands, gardens, orchards) increased provisioning rate, though the effect was not significant. However, the interaction between chicks' age and high-quality habitats was highly significant, indicating that in territories with lower proportion of high-quality habitats, provisioning rates reduced with chicks' age, which can ultimately affect chick survival. These results will be crucial to inform conservation interventions for the species.

Key words: Little Owls, prey composition, provisioning rate, habitat quality, weather.

51

A spectrographic overview of adult Eurasian Eagle Owl (*Bubo bubo*) vocalizations and behavior in southern Limburg, The Netherlands

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Bioacoustic monitoring of birds is becoming a more commonly used research tool. For it to be successful, a thorough understanding of the behavioral context of a bird's vocalizations is required. Until recently, researchers have described Eurasian Eagle Owl (*Bubo bubo*) vocalizations phonetically. The increasing availability of Automated Recording Units (ARUs) and sound analysis software now makes quantitative spectrographic analysis much more accessible. Herein I give an overview of the adult vocal repertoire of the Eurasian Eagle Owl by combining spectrograms with descriptions of the associated behaviors I observed and phonetic descriptions from published literature. In June 2016, I began collecting recordings as part of bioacoustic monitoring for vocal identification of individual Eurasian Eagle Owls in a quarry in the southern part of the Netherlands. I used ARUs programmed to record from one hour prior to sunset until one hour after sunrise, the period in which Eurasian Eagle Owls are most vocally active. Recorders have operated nearly year-round since 2016 and monitoring continues. I observed Eurasian Eagle Owls at least twice per week year-round to record which behaviors were associated with different vocalizations. I analyzed recordings using Audacity and Kaleidoscope Pro software. Eurasian Eagle Owls have five main vocalization groups, with each group containing multiple types of vocalizations. I discuss the functions of different vocalizations and how this information is important to future research, monitoring, and conservation of the Eurasian Eagle Owl.

Key words: ARUs, vocalizations, bioacoustic monitoring, Eurasian Eagle Owl, Bubo bubo.

Eurasian Eagle Owl, Zaragoza, Spain.

52

Exposure and effects of lead in owls: a comprehensive review

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Lead is a heavy metal with no biological function, making it particularly toxic to living organisms. Despite the fact that many uses of lead have been restricted or banned, lead has many allowed uses and remains readily bioavailable in the environment. Raptors have been a particular taxa of focus for research and monitoring of exposure and effects of lead, but this largely has focused on diurnal raptors, especially eagles and vultures, who are known scavengers. Owls have received little attention as it relates to lead exposure and effects, at least in part due to scarcity of documentation for owls as scavengers. The contaminant literature for owls shows that (1) genera studied include *Tyto*, *Aegolius*, *Athene*, *Bubo*, *Otus*, and *Strix*, (2) most owl research has been conducted in North America, Europe, and Asia, with little work done in South America, Africa, and Australia, and (3) sources of lead for owls mainly include spent ammunition, mining, and industrial. In owls, lead monitoring studies have predominated, using non-lethal techniques such as feathers, pellets, and feces, or diagnostic necropsy examination. Very few biomarker studies have been conducted with owls, with the main biomarker analyzed being δ-ALAD activity. As recent reports show, owls will scavenge carcasses in some situations, which would greatly increase their chances of lead exposure from spent ammunition, and thus secondary poisoning. Being top predators, owls can serve as sensitive biomonitors of environmental contamination, thereby providing an early warning system to potentially dangerous environmental levels of lead and other toxic compounds.

Key words: owls, lead, exposure, effects, biomonitors.

53

Prey selection and reproduction in Barn Owls (*Tyto furcata*) inhabiting an arsenic-contaminated hazardous waste site in Texas, USA

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Adult Barn Owls (*Tyto furcata*) and their offspring were observed roosting and nesting on an EPA Superfund hazardous waste site in the Houston, Texas area. The owls utilized a small brick building on the site, the only structure remaining following emergency containment at the site completed by the EPA in 1983. Observations of the owls were made from April 1988 through November 1990. Regurgitated pellets were collected at 17 different sampling times covering all months of the year from December 1988 through

November 1990. The Barn Owl pair reproduced five times during the period from April 1988 through November 1990, and produced ten known fledglings. Diet analysis from the pellets revealed that, although the hispid cotton rat, *Sigmodon hispidus*, was the most frequent prey species taken (37.6%), the broad-tipped cone head katydid, *Neoconocephalus triops* (Insecta: Tettagoniidae) was taken just as often (37.4%). Mammals made up only 60.7% of prey items, but biomass of mammalian prey was 96.5%. Birds made up about 2.0% of prey items and about 2.7% of prey biomass. Although the frequency of katydids in the diet was surprisingly high, these insects made up only 0.85% of the prey biomass. The frequency of insects in the Barn Owl diet is surprising in that there was an abundance of small mammals at the hazardous waste site and also because small mammals make up from 84.3-99.7% of the Barn Owl diet in Texas. The hispid cotton rat was the most important prey species at the site by biomass (72.5%), but it is thought that owls chose to prey upon katydids at the site because of their numbers, ease of capture, and their habit for stridulating at night. It is not known if high levels of arsenic on and around the site influenced prey availability and therefore prey selection, or reproduction.

Key words: barn owl, Tyto furcata, arsenic.

54

Why including children in owl research is important to inspire the next generation of researchers

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Over the past 40 years while conducting research on a variety of owl species in Massachusetts I have included my children and grandchildren in observing, capturing, banding, color marking, attaching transmitters, collecting pellets, fostering orphan owlets in foster nests, and doing educational programs on owls for children and adults. I learned how important it was to include them in every aspect of the research as they often came up with ideas I would have never thought of or would have tried. After helping out on a variety of research projects over the years they came up with better methods for placing orphan owls in foster nests, using ammonia to deter predators from finding those nests, where to color marking snowy owls so the markings would be visible to observers tracking them, in addition to collecting pellets observations on prey captured needed to be done to get a complete picture of what they were eating as some prey items do not show up in pellets. One of my assistants as a freshman in high school started her own research project in Massachusetts capturing saw-whet owls showing the owl experts that these little owls were not as uncommon as we thought, and were in fact the most common owl species in the fall. We can all do a better job of getting the next generation to better understand, appreciate and care for the world around us.

Key words: children in owl research, citizen-science.

55

Do owls of a feather molt together? Molt and aging of Great Grey Owls (*Strix nebulosa*) in Scandinavia

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Molt and aging of Great Grey Owls have formerly been described, however not for the third molt stage (M3). We collected wing photos of Great Grey Owls to build upon molt descriptions of this species, specifically looking for owls in M3. Most birds were captured as nesting adults in Hedmark county, SE Norway in 2010-2023. We collected photos of outstretched wings of 59 owls: 12 in first molt stage (M1), 26 in second molt stage (M2) and 21 in M3. Of these 59 owls: 5 in M1 were banded as nestlings; 9 in M2 were banded as nestlings or while in M1; 7 in M3 were banded as nestlings and 2 as nesting 4CY birds while in M2. With these 23 banded birds as blueprints, we interpreted ages of the 36 remaining unbanded individuals. During the first molt, all banded owls retained 10 to 18 juvenile feathers per wing (mean 14.5 juvenile feathers). Interpretation of M1 is thus fairly unambiguous. Banded birds of known age in M2 retained 0 to 10 juvenile flight feathers per wing (mean 2.6 juvenile feathers). Three banded birds had surprisingly lost all juvenile wing feathers after M2. Unbanded birds were interpreted as being in M2 when all or most of the innermost secondaries S 9-11 were bleached and lighter colored than secondaries further out in the wing. Of the 9 banded birds in M3, 8 had no juvenile flight feathers left while one bird had retained P1 and 2 as juveniles. For all M3 birds S9 was always new and darker than secondaries further out. One to two retained juvenile feathers are not sufficient to classify an unbanded owl as 4CY or 5CY of age. The appearance of old or new inner secondaries may however indicate if the owls have molted 2 or 3 times.

Key words: Great Grey Owl, molt, aging.

Bjørn Jacobsen and Trond Berg with Great Grey Owl satellite tagged male owl "Trond", June 2018.

56

Parental provisioning and resource variation in Flammulated Owls (*Psiloscops flammeolus*) breeding in northern Utah

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Climate change is affecting the timing of snowpack and drought trends in western mountain habitats, which may also cause fewer and more clustered high-quality territories for insectivorous birds. As resources fluctuate in these regions, birds that produce altricial young may face increased challenges when providing food resources to their offspring. Parental provisioning and division of labor by breeding pairs exposed to these changing conditions may require shifts to keep up with the needs of the nestlings. We attempted to estimate food provisioning rates and labor partitioning between parental Flammulated Owls (*Psiloscops flammeolus*) for their offspring across territories with variable foraging quality characteristics. We (1) captured and marked adult female owls in occupied nests to differentiate them from their male mating partners, (2) mounted motion-activated trail cameras inside occupied nests to record food deliveries throughout the nestling period, and (3) utilized insect traps to assess the habitat quality surrounding each occupied nest. Preliminary analyses of video data suggest that female owls will adjust their level of provisioning involvement based on differences in clutch sizes and abundance of food resources present around the nest. Smaller clutch sizes are associated with lower levels of female involvement. Conversely, larger clutches require females to invest energy into food provisioning both earlier in the nestling period and with higher overall intensity. By comparing provisioning rates across multiple breeding seasons and in a variety of territory qualities, we will be able to understand better how these owls may adjust their provisioning strategies in response to environmental changes over time.

Key words: parental provisioning, life history, territory quality.

57

Status assessment and conservation priorities for the Snowy Owl (*Bubo scandiacus*) across its circumpolar range

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The global population of Snowy Owls (*Bubo scandiacus*) is particularly difficult to assess due to their wide-ranging annual dispersal movements, circumpolar distribution with a breeding range restricted to the remote Arctic tundra, and nomadic and irruptive behavior. Ongoing long-term Arctic breeding surveys as well as indexes during the wintering period suggest the world population of Snowy Owls is most likely much lower than previously estimated. This project is an effort led by the International Snowy Owl Working Group (ISOWG) and researchers around the globe to assess population trends and the current global status of the Snowy Owl. We reviewed the ecology, population status, and threats for the circumpolar population of Snowy Owls. We used recent genetic analyses and long-term datasets to provide the most reliable estimate of their world population as well as ongoing trend. Results from both long-term ecological monitoring and genetics suggest a lower population estimate than previously thought and decreasing trends across the entire

species range, although not significantly so in some cases. We conclude that the Snowy Owl warrants special attention across its range and maintaining or establishing long-term monitoring programs would be critically relevant especially within its breeding range. Other recommendations to orient conservation efforts include the assessment of limiting factors acting on survival and reproductive rates (e.g. contaminant analyses) and migration connectivity (using telemetry and/or stable isotope analyses).

Key words: population trends, long-term monitoring, survival and reproductive rates.

Snowy Owl, adult female.

58

Northern Hawk Owl (*Surnia ulula caparoch*) winter habitat use and movement in Minnesota and Manitoba

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Northern Hawk Owls (*Surnia ulula caparoch*) are one of the least studied birds in North America. Like many boreal forest species, the global range of hawk owls is predicted to shrink dramatically as northern forests recede in response to climate change and deforestation. Conservation of hawk owls requires the understanding of hawk owl habitat use and range during the annual cycle, including activity in winter conditions. Although many unknowns exist for this species, winter research is a top priority. Little is known about how far individuals travel from their breeding/natal grounds or whether they establish a winter territory. We implemented the novel use of GPS-GSM transmitters to monitor the activity and movement of 11 hawk owls in northern Minnesota and southern Manitoba. The data from these individuals was used to determine if they had a winter home range and if selection occurred based on habitat variables. eBird occurrence data was used to create a species distribution model (SDM) through Maximum Entropy modeling to provide insights into land cover use and try to identify which variables showed a higher habitat suitability index. Winter home ranges were smaller than expected (range: 2.11 – 34.75 km^2) and were distinct from breeding ranges. Additionally, hawk owls selected for wetland habitat and were positively associated with edge characteristics in both analyzes, but wetland habitat mattered more in Minnesota compared to Manitoba. Our results provide novel data on hawk owl winter habitat use and highlight the importance of winter data for informing monitoring and land management plans.

Key words: habitat use, telemetry, winter movement.

Northern Hawk Owl, Saskatchewan, Canada.

59

Prey as a determining factor for the success of Barn Owls *Tyto alba* in Friesland, The Netherlands

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Prey availability has a large impact on clutch initiation, clutch size, and brood size of Barn Owls, as well as on body condition of the chicks. Quantitative data on prey availability are rarely available to verify such relationships. Additionally, numerical surveys of small rodents may differ significantly from the rodents' accessibility for the owls, due to e.g. vegetation cover. In this study we determined population size and breeding results of Barn Owls in relation to their main prey, the Common Vole *Microtus arvalis*, in landscape types characterized by soils of sand, peat and clay in the northern Netherlands in 1981-2014. We used pellet analysis to assess the importance of voles in the owl's diet. The Common Vole is the staple food of Barn Owls throughout The Netherlands and vole dynamics are considered to govern population size, breeding success, and chick body condition. We used a relative index to monitor vole density twice yearly (March and August), by counting re-opened burrows in fixed plots. Numbers of breeding pairs of Barn Owls peaked simultaneously in each of the three habitats, indicating that prey availability showed the same trend across the different regions. Population size and brood size of owls were positively correlated in all three regions. In the sand region, body condition was not positively related to population size or brood size. Common Voles, as shown by pellet analysis, positively correlated with population size and breeding parameters of Barn Owls living on peat and clay soils, but not when inhabiting sandy soils. The vole index, however, showed a much stronger relationship between relative vole abundance and population size and breeding performance of Barn Owls on sandy soils compared to those living on peat and clay soils. Differences in methodology for measuring prey availability and usage interact with region-specific variation in ecology.

Key words: predator-prey relationships, breeding performance, Barn Owl, Tyto alba, Common Vole, Microtus arvalis.

Barn Owl nestlings in nestbox, Denmark.

60

Current insights into the taxonomy and geography of the Little Owl (*Athene noctua*)

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Taxonomy and geographical distribution of widespread owl species remains a challenge due to initial morphological approaches when subspecies were described, biased sampling of subspecies across their range, and lack of genetic evidence or vocalization studies. Herein, we provide an overview of historical and recent morphological, genetic and vocalization insights complemented by validated and geocoded photographs and vocalization recordings of the different subspecies of *Athene noctua* in a global context. Morphological and genetic analysis confirmed the relevance of *A. n. sarda* and *A. n. impasta*. A suggested split into *A. vidalii* (Little Owl) and *A. noctua* (Cucumiau) (Robb & Sound Approach, 2015) based upon specific combinations of vocalizations were insufficiently proven distinguishable to be valid. A suggested split of *A. lilith* (Lilith Owlet) as a separate species (König et al. 2015) in the Middle East and Arabia based upon an unreferenced genetic study from SE Turkey remains to be proven. Our results did not support such a split but revealed a possible *glaux*-like *lilith* variant in Arabia alongside *A. noctua saharae*. A suggested split of *A. spilogastra* (König et al. 2015) in Ethiopia and Somaliland into *A. spilogastra* (Ethiopean Little Owl) with two subspecies *A. s. spilogastra* and *A. s. somaliensis*) makes more sense but is not thoroughly researched enough yet for a real split. Suggestions for complementary genetic and vocalization research are given to consolidate the Arabian and Eritrean/Somalian open questions.

Key words: Little Owl, taxonomy, global distribution, subspecies.

Little Owl, blistery day, Extremadura, Spain.

61

50 Years of reproduction of the Little Owl (*Athene noctua*) in The Netherlands

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The Little Owl is a species characteristic of the small-scale, semi-open agricultural landscape. Little Owls are sensitive to agricultural intensification and the loss of small-scaled habitats, which means that nesting opportunities in pollarded trees, high-stem fruit trees and buildings disappear, and the food supply decreases and eventually disappears. As a result, the number over the past 50 years show a negative trend. However, the numbers have recently stabilised, particularly on the sandy soils of the eastern and southern parts of the Netherlands, with even some local increase. The population size of the Little Owl is mainly determined by its reproductive success which will be discussed based upon 32,623 nest records from the period 1971-2022 (Sovon Vogelonderzoek Nederland). The number of nesting records per year increased spectacularly over the years, from a few dozen in the 1970s and 1980s to more than 2000 annually in recent years. Until the mid-1980s, almost all data originated from Piet Fuchs' research area in the Betuwe. Since 2000 research in almost all important regions where the species occurs and standardized methodologies and more intensive fieldwork boosted the representativeness of the data set in order to assess national trends. At the same time, we also see an increase in the quality of the data collected due to educational work of STONE and Sovon. The long-term evolution of reproduction parameters (clutch size, number of young on the ringing date, young fledged per successful nest and per breeding attempt (breeding success) are studied. Over the period 1996-2022 the dataset is much more robust in terms of size and distribution across the country and enriched with prey availability data for the Achterhoek region. Our results show that the Little Owl population in the Netherlands is stable since 2000. Nationally, the number of breeding pairs is slowly increasing, mainly on sandy soils and reproduction variables have remained stable for the last 25 years and high enough to compensate for the mortality of adult birds.

Key words: Little Owl, The Netherlands, reproduction, population development.

Little Owls, Evora, Portugal.

62

Climate change and owl interactions: case study of sympatric *Strix* owls

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As apex predators, owls are affected by ecosystem changes caused by climate change. In a temperate montane mixed forest in Slovenia (south-central Europe), we conducted a long-term study of the coexisting populations of Ural *(Strix uralensis)* and Tawny Owl *(S. aluco)* during the period 1998-2021, in which the winter temperatures increased by 1.7 °C. By annually surveying owl territories and nests in nest boxes, we found that Ural Owl was restricted to higher elevations and Tawny Owl to lower elevations. In terms of territory occupancy, the Tawny Owl population was increasing by 2.6% and the Ural Owl by 5.2% annually, resulting in a higher rate of shared territories and greater competition for nest sites, which was particularly intense at higher elevations. After 2010, due to several extreme rodent years, increased nest displacements of the smaller Tawny Owl by the larger Ural Owl and even mixed nests were observed, where the Ural Owl continued to incubate the Tawny Owl clutch and successfully raised Tawny Owl chicks imprinted by the Ural Owl. In direct competition between owls, size matters, as the larger Ural Owl is more successful in taking over Tawny Owl nests. Mean head length of female Ural Owls in overlapping territories with Tawny Owls was larger than in females in non-overlapping territories. This suggests that competition with Tawny Owls appears to select larger Ural Owl individuals that are more competitively successful. This hypothesis is also supported by the size differences found in Ural Owl populations across the species range, where Ural Owls sympatric to Tawny Owls were much larger than allopatric populations. With continued climate change, consequent increased frequency in small mammal peak years and expected intensified competitive interactions between the owls, advanced body size difference might be the path to co-existence of the two species.

Key words: competition, nest displacement, coexistence, natural selection, long-term research.

Ural Owl, Norway.

63

Project SNOWstorm at 10: building collaborative, crowd-funded owl research

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In response to one of the largest irruptions of Snowy Owls (*Bubo scandiacus*) into eastern North America on record in the winter of 2013-14, Project SNOWstorm (www.projectsnowstorm.org) was formed to learn more about the winter movement ecology, migratory behavior, and health status of this Arctic raptor. From the beginning, SNOWstorm has taken a highly collaborative approach, involving banders; academic, agency and NGO researchers; and wildlife veterinarians and pathologists, most of whom donate their time. Funding has come almost exclusively from small, crowd-funded, tax-deductible donations from the public, and underwriting (usually in the form of transmitter sponsorships) from state or regional ornithological and birding groups. In its first decade, Project SNOWstorm has used GPS/GSM transmitters to follow more than 115 Snowy Owls in 17 states and provinces, generating what we believe to be the largest movement dataset for this species in the world. Our veterinary team, in collaboration with a wide range of agencies, rehabilitators and institutions, has necropsied more than 450 accidentally killed and salvaged owls, creating the world's largest dataset on Snowy Owl health, disease, and exposure to environmental contaminants. Project SNOWstorm has also partially underwritten important research, including the first comprehensive global population status and trend assessment for Snowy Owls. This presentation will summarize Project SNOWstorm's genesis, history, and achievements, and outline the ways in which it may serve as a model for similar research approaches.

Key words: Snowy Owl, collaborative research, crowd-funding, telemetry, necropsy.

Mike Blom releasing a satellite tagged Snowy Owl in Alberta, Canada. March 2019.

64

Depredation of seabirds by invasive Barn Owls (*Tyto furcata*) on Kauai, HI: Diet quantifications from stable isotope analysis

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Seabirds are one of the most threatened groups of vertebrates, and their monitored populations have declined by roughly 70% between 1950 and 2010. Invasive predators are a major source of seabird mortality worldwide, but invasive avian predators such as owls may pose a distinct threat to seabirds on larger islands. Here, island-wide eradication is often infeasible and commonly employed predator-proof fences cannot contain owl movement. In the Hawaiian Islands, invasive Barn Owls (*Tyto furcata*) are known to kill endemic seabirds such as the endangered Hawaiian Petrel (*Pterodroma sandwichensis*). However, the frequency of such depredation events is largely unknown. With the goal of informing predator removal strategies, we quantified the diet of over 50 Barn Owls on the island of Kauai, HI using stable carbon and nitrogen isotope ratios in their feathers. We employed stable isotope mixing models to distinguish rodents and other terrestrial diet items from marine foods (seabirds). We found significant variation in diet among individual owls, with 0 to >50% of diet deriving from seabirds.We further quantified wing morphology and discovered that wing loading (but not body mass) was a significant predictor for the percent of seabirds in the Barn Owl diet. This finding suggests that owl depredation of seabirds mainly occurs in flight, rather than at the nesting burrows, and that only a portion of owls are adept at seabird capture. Based on our data, we recommend protecting seabird flyways to limit further depredation.

Key words: diet, stable isotope, invasive predator, wing morphology, foraging.

65

Burrowing Owl (*Athene cunicularia hypugaea*) monitoring, conservation, research, and translocation in San Diego County, California, USA

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Successful management of Western Burrowing Owls (BUOW, *Athene cunicularia hypugaea*) and their grassland habitat in San Diego County depends on a thorough understanding of their population dynamics. Since 2013, we have monitored up to 44 breeding burrows per year, and captured and banded over 800 BUOW, providing valuable information regarding survivorship and productivity. Apparent survival of both adults and juveniles is highly variable across years, which may affect long-term population stability in the region. Through our monitoring and research efforts, we continue to gain a better understanding of local factors that may influence productivity and survival, using a scientific framework for informing wildlife management decisions in the region. Local conservation management goals include increasing the number of breeding sub-populations to guard against extirpation of BUOW from the county. Through a systematic and collaborative effort, we identified two sites suitable for expanding the BUOW population. A population viability analysis utilizing three years of local demographic data predicted positive population growth from a small initial translocated population. Site preparation techniques included vegetation management, targeted enhancement of the California Ground Squirrel (*Otospermophilus beecheyi*) population, and retrofitting/installation of artificial burrows. In 2018, we began translocating BUOW using a soft-release technique. Over successive breeding seasons, we have documented reproduction and retention of translocated owls, recruitment of their offspring, and recruitment of non-translocated owls. Here, we detail our methods and findings, and discuss leveraging our collaborative efforts to achieve conservation and management goals with limited resources.

Key words: Burrowing Owl, management, survival, productivity, translocation.

66

Effects of night safari on the vocalizations of Lanyu Scops Owl (*Otus elegans botelensis*) on Lanyu Island, Taiwan

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The impact of tourism on owls has rarely been studied. The Lanyu Scops Owl (*Otus elegans botelensis*) is an endemic bird species that inhabit the forest of Lanyu Island off Taiwan. During the breeding season, male owls use vocalization to find mates and defend territories. As one of the main tourist attractions, owl-watching at night is a popular night event. The main travel season on the island occurs from April to September, which overlaps with the breeding season of the owls. Over the past decade, the number of tourists visiting the island has increased sharply. This has resulted in many tourists visiting the forest at night. The noise generated by tourists, their flashlights, and artificial hoots may interfere with the breeding activities of the owls. In this study, we used automatic sound recorders to record night soundscape of the forest, with the aim of understanding tourist behavior and its impacts on the calling activities of Lanyu Scops Owls. In the travel season of 2022, we set up recorders along the hiking trails in the two most popular night safari areas. In each area, we set recorders at both the entrance and interior of the forest. In total, we collected 10,859 five-minute audio files and identified 351,712 vocalizations of the owls. Most visitors participated in night safaris before midnight and on rain-free days. Visitors were mostly observed at the entrance of the forest, they seldom went into the interior. Lanyu Scops Owls exhibited a significant increase in vocalizations when encountering visitors compared to when there were no visitors. We conclude that current night safari activities will prompt Lanyu Scops Owls to increase their calling activities.

Key words: automatic recorder, human disturbances, Otus elegans botelensis, owl-watching, soundscape.

This World Owl Conference is dedicated to the memory of two inspirational giants of owl research and conservation …

Dr. Robert (Bob) William Nero (1922-2023)

Dr. Robert W. Nero with Lady Gray'l and his late wife Ruth Nero. Photo: Birch Nero.

Dr. Nero was a world-renowned naturalist, ornithologist, conservationist, archaeologist, educator, and poet. He was also my former academic supervisor, a dear friend and mentor. Bob passed peacefully in Winnipeg, Manitoba this past January not long after his 100th birthday. His passionate influence touched many professionals and non-professionals over many decades. He was a prolific writer, publishing hundreds of articles and books on natural history and a plethora of other subjects. His association with the Great Gray Owl (*Strix nebulosa*) started in 1968 when he learned about an active nest near The Pas, Manitoba. He travelled 800 km to study it and over the following decades became a world expert on this species. This culminated in 1980 with the publication of his classic book "Great Gray Owl: Phantom of the Northern Forest". In 1984 he rescued a young Great Gray Owl he called Lady Gray'l and together they gave 100's of public owl talks. Bob and Lady Gray'l were a significant inspiration for the establishment of the World Owl Hall of Fame initiated in 2006. Bob also initiated the first international gathering of owl researchers in Winnipeg, Manitoba, Canada in 1987 and was the lead editor of the associated proceedings. This conference was followed by six subsequent international owl symposia, held in Canada, Australia, Netherlands, Portugal, India and presently in La Crosse, Wisconsin, USA. To learn more about Bob's many significant lifetime achievements, awards and contributions to science and art please visit

https://bluejayjournal.ca/index.php/bluejay/article/view/6377/6363

Dr. James R. Duncan, Discover Owls

Drs. Johan de Jong (1941-2022)

In 1973, Johan became fascinated by the Barn Owl during his Biology education, and the love for this owl remained with him ever since.

With the help of many volunteers, he shaped the protection of the Barn Owl in Friesland and the Netherlands, with specific focus on research and education. The research provided a solid basis for protection purposes as well as for getting the general public excited about this mystic creature. Johan compiled 4 books in total; the last book was published in the summer of 2017, a significant standard reference for the Barn Owl. Fortunately, Johan was also able to update and complete the field manual for Dutch Barn Owl volunteers in 2022. With this he passed on his lifetime experience in a guide for the protection of the Barn Owl. One of his last projects was the development, testing and placement of safe perching posts for Barn Owls along the highways, resulting in significantly fewer road casualties.

His conservation work also had international significance. In 2007, he chaired the World Owl Conference in Groningen.

Johan has received several national and international awards for his conservation work for the Barn Owl. In the last years of his life, Johan set a goal of obtaining a PhD using all of his collected research material in order to make it accessible to everyone. Unfortunately, he was not able to complete this task.

We miss Johan, he was an inspiring person and shared his love, knowledge and wonder about birds and nature with many people, of all ages and through various media. He flew away from us, like a Barn Owl in the night. As the Dutch Barn Owl Foundation, we feel privileged to continue his life's work.

On behalf of the Stichting Kerkuilen Werkgoep Nederland

Ruud Leblanc, Mark Hessels, Mary Mombarg