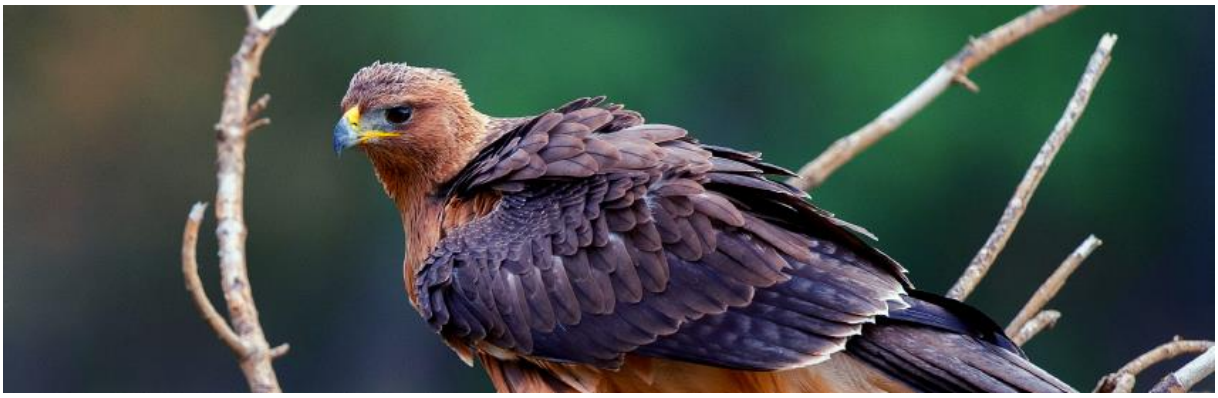
2ème Symposium Aigle de Bonelli

23&24 septembre 2021 à Montpellier

RESUMES

ABSTRACTS



PLAN NATIONAL D'ACTIONS EN FAVEUR DE L'AIGLE DE BONELLI

ORGANISÉ PAR Conservatoire d'espaces naturels Occitanie

EN PARTENARIAT AVEC

PRÉFET DE LA RÉGION OCCITANIE

Conservatoire d'espaces naturels Provence-Alpes-Côte d'Azur

LPO

AGIR pour la BIODIVERSITÉ AUVERGNE-RHÔNE-ALPES

AUTRES SOUTIENS FINANCIERS

PRÉFET DE LA RÉGION OCCITANIE

La Région Occitanie Pyrénées · Méditerranée

ENEDIS L'ELECTRICITE EN RESEAU

Session 1

La Conservation de l'Aigle de Bonelli en Méditerranée

The conservation of Bonelli's Eagle in the Mediterranean area

Evolution spatiale des domaines vitaux de l'Aigle de Bonelli en France : enseignements pour la conservation

Patrick Boudarel[1] & Olivier Scher[2]

[1] DREAL occitanie, Montpellier, Patrick.BOUDAREL@developpement-durable.gouv.fr
[2] CEN Occitanie, Montpellier, olivier.scher@cen-occitanie.org

L'Aigle de Bonelli est un rapace discret dont les sites de reproduction n'ont commencé à être vraiment suivis qu'à partir des années 60-70 et surtout 80. Les première compilations de ces données historiques par divers auteurs (voir Cheylan *et al.* 1998), revalidées par le Plan national d'actions en faveur de l'Aigle de Bonelli (PNA AB) à la fin des années 2000 ont permis d'estimer à environ 80 couples la population française de cette espèce avant 1960. Le suivi exhaustif des couples nicheurs depuis 1990 au travers du programme personnel de baguage porté par G. Cheylan puis N. Vincent-Martin et enfin C. Ponchon a depuis permis de contrôler finement ses évolutions.
En parallèle, une action phare du PNA AB a été de cartographier à partir de 2008 le plus précisément possible les domaines vitaux (DV) de l'espèce en s'appuyant dans un premier temps sur une méthode cartographique tenant compte de des observations de terrain, les habitats favorables et la taille moyenne des DV. Depuis 2009, elle a pu être confirmée, mise à jour et affinée parle suivi télémétrique des adultes (28 DV concernés à ce jour). Cet outil public permet tout à la fois de limiter les menaces liées aux nouveaux aménagements et de cibler les lieux d'actions du PNA AB (notamment réduction des risques sur les lignes électriques).
En nous basant sur ces cartographies et ne considérant que les sites occupés par un couple (individus isolés non pris en compte), nous proposons une reconstition de la dynamique d'occupation spatiale de ces domaines vitaux afin de (1) décrire leur régression et expansion au cours du temps, (2) relier cette dynamique à celle de la population nicheuse et (3) identifier les hypothèses pouvant expliquerces observations.
L'examen de ces données nous permet de valider le choix du PNA AB qui a consisté à préserver à la fois les sites occupés et vacants, met en avant le potentiel supplémentaire de recolonisation de l'Aigle de Bonelli en France (avec 9 DV non historiques colonisés depuis 1990 + 2 par densification dans des DV occupés) et met en évidence, au-delà de la pression anthropique, le rôle de frein non négligeable de l'Aigle royal dans cette reconquête.
Une poursuite de cette recolonisation est donc possible (et nécessaire), sachant toutefois que les deux types de pressions précités ne vont qu'en augmentant.

Spatial evolution of Bonelli's Eagle home ranges in France: lessons for conservation

Patrick Boudarel[1] & Olivier Scher[2]

[1] DREAL Occitanie, Montpellier, Patrick.BOUDAREL@developpement-durable.gouv.fr
[2] CEN Occitanie, Montpellier, olivier.scher@cen-occitanie.org

Bonelli's Eagle is a discreet bird of prey whose breeding sites were only really monitored from the 1960s-70s and especially the 1980s. The first compilations of these historical data by various authors (see Cheylan *et al.* 1998), revalidated by the PNA AB (National Action Plan for Bonelli's Eagle) at the end of the 2000's, allowed to estimate the French population of this species at about 80 pairs before 1960. The exhaustive monitoring of breeding pairs since 1990 through the personal ringing program carried out by G. Cheylan, then N. Vincent-Martin and finally C. Ponchon has since made it possible to finely control its evolution.

In parallel, a flagship action of the PNA AB has been to map as precisely as possible the home ranges of the species based initially on a mapping method taking into account field observations, favorable habitats and the average size of the home ranges. Since 2009, it could be confirmed, updated and refined by telemetric monitoring of adults (28 HR concerned to date). This public tool allows both to limit the threats related to new developments and to target the locations of actions of the PNA AB (including risk reduction on power lines).

Based on these maps and considering only the sites occupied by a pair (isolated individuals not taken into account), we propose a reconstruction of the dynamics of spatial occupation of these home ranges in order to (1) describe their regression and expansion over time, (2) link these dynamics to those of the breeding population and (3) identify hypotheses that could explain these observations.

The examination of these data allows us to validate the choice of the PNA AB which consisted in preserving both occupied and vacant sites, highlights the additional potential of recolonization of Bonelli's Eagle in France (with 9 non-historic HR colonized since 1990 + 2 by densification in occupied HR) and highlights, beyond the anthropic pressure, the non-negligible role of the Golden Eagle in this reconquest.

A continuation of this recolonization is thus possible (and necessary), knowing however that the two types of pressures mentioned above will only increase.

A large raptor on a tiny island – dispersal patterns of Bonelli's Eagles (Aquila fasciata) in the Aegean Islands

A. Dimalexis, L. Sidiropoulos, A. Mayrose, A. Sagiakou, N. Probonas

The Bonelli's Eagle (BE) is considered sedentary, yet the juveniles are going through a transient post-fledging dispersal phase, in which they fly tens or hundreds of kilometers away from their natal sites. The BE is a large terrestrial raptor that is usually avoiding flight over large water-bodies, where convective updrafts are scarce. The dispersal patterns of the BE population that occupy the Aegean islands is hence a unique scene to look into the decision-making considerations of the eagles, where on the one hand there are some intrinsic and environmental pressures towards dispersal, while on the other are the risks associated with sea-crossing. In this region, the BE are nesting on a range of islands, from large ones such as Crete, to some tiny islets of only few squared kilometers. A telemetry study was recently initiated to examine the dispersal patterns of the eagles that inhabit small versus medium and large islands, and their implications on the species' survival and conservation.

The results from the first year of study show significant differences between these populations, with eagles fledging on larger islands dispersing within the islands, whereas eagles fledging on the smaller islands dispersing either to adjacent islands of the same archipelago, or to mainland Greece and Albania. The timing of sea-crossing shows a strong correlation with favoring weather conditions, which are rare in the Aegean during the dispersal onset period.

The survival rate exhibited by the Aegean BE dispersing to the mainland is relatively low, where interactions with powerlines taking a heavy toll. Rapid development of wind-energy and powerline infrastructures in the area that serve as a bottleneck for BE dispersal, may increase the discrimination between dispersal strategies, yielding a stronger selection toward the shorter dispersal patterns, hence changing the Aegean population behavior, connectivity to the mainland and genetic flow.

Population status and conservation of Bonelli's eagle in Cyprus

Kassinis, N.[1], Mayrose, A.[2] and H.Hadjistillis[1].

[1]Game and Fauna Service, Ministry of Interior, Cyprus.

[2]Haifa University, Israel.

The Bonelli's eagle (BE) is the only eagle species breeding in Cyprus. It nests mostly on large pine trees, and to a lesser extent on cliffs. There are currently about 40 nesting territories known in areas under Cyprus Government control and at least 10 more on the Turkish-occupied north Cyprus, hence the Cypriot BE population is probably the most dense in the eastern Mediterranean basin (with an average of 5.4 pairs/1000 km²). An EU co-funded Project named LIFE BONELLI EASTMED is been implemented since September 2018 and will last until February 2023. This international project with partners from Greece and Cyprus aims at the conservation of the BE population in eastern Mediterranean. Through the project, threats are been identified and conservation actions addressing these are being implemented. During 2019, 36 active territories were identified with information on nesting success coming from 17 nesting sites, priority given to the 4 project SPAs. The average nesting success was 1.6 fledgling/successful nesting pair where 14 pairs fledged 22 eaglets (8 pairs with 2; 6 pairs with 1), whereas 2 nests were deserted during incubation and in 1 nest 2 eaglets died before fledging. Sixty-eight percent of nesting sites were on Pine trees, 21% on cliffs whereas 11% of pairs had both a tree and a cliff nest. In 2020 and 2021 nesting seasons, the average nesting success was 1.8, data coming from 21 successful pairs. A pair in 2020 fledged 3 eaglets. Telemetry study that initiated in 2019 with 35 eagles GPS-tagged so far revealed that eagles that fledge in Cyprus normally disperse within the island (i.e. none of the tagged individuals has migrated). It also shows a clear discrimination between adult territorial occupancy, occurring mostly in the mountainous, rugged and forest areas of the island, while juveniles disperse to the lowlands, near wetlands, the coastal plains and to Mesaoria (central) valley. Important foraging areas have been identified in parts of the UN-patrolled Buffer Zone. These areas are to a large extent devoid of human activities, and are rich in prey. In the period 2019 -2021, 12 out of 35 Bonelli's eagles tagged with GPS/GSM loggers, were found dead or injured. Shooting was involved in 42% of cases, whereas for the first time electrocution (2 cases) and collision in wind farms (1 case) were documented. Poisoning involved 2 cases, one was secondary poisoning - rat poison / bromadiolone). Remarkably, the last case is the first reported case of secondary poisoning involving a large raptor in Cyprus. Through project conservation actions, retroffiting of specific electricity pylons has been carried out, rafts have been placed in potentially dangerous watertanks in the mountains, the access to specific roads has been controlled and potentially dangerous powerlines have been identified so they will be marked in the near future.

The LIFE ConRaSi project in Sicily.

Di Vittorio M.[1,4], Merlino S.[1,4] , Luiselli L.[2] , Lo Valvo M.[3], Cortone G.[1], Scuderi A.[1,4], Àlvarez Xusto E.[5], Martìnez Dalmau J.[5], Egea-Casas O.[6], Lòpez Lòpez P.[6]

[1] Ecologia Applicata Italia, Termini Imerese (PA), Italy.
[2] Department of Applied and Environmental Biology, Rivers State University of Science and Technology, PMB 5080, Port Harcourt, Rivers State, Nigeria.
[3] Dipartimento di Scienze e Tecnologie Biologiche, Chimiche e Farmaceutiche, Laboratorio di Zoologia applicata, University of Palermo, Palermo, Italy.
[4] Gruppo Tutela Rapaci, Moio Alcantara (ME), Italy.
[5] GREFA (Grupo de rehabilitación de la Fauna Autoctona y su Habitat) , Calle Monte del Pilar, Majadahonda, Madrid, Spain
[6] Movement Ecology Lab, Cavanilles Institute of Biodiversity and Evolutionary Biology, University of Valencia, Valencia, Spain.

Since 2016, the LIFE ConRaSi Project (LIFE14 NAT / IT / 001017) has been underway in Sicily to improve conservation measures for Bonelli's Eagle (Aquila fasciata), Lanner falcon (Falco biarmicus) and Egyptian vulture (Neophron percnopterus). These three species have experienced severe population declines and are priority species for conservation in Europe.
The developed main actions include: 1) nest surveillance by volunteers and GPRS camera-traps and continuous networking with law enforcement agencies to control eggs and chick robbery; 2) intensive field monitoring of the populations and demographic analyses to assess population dynamics; 3) GPS/GSM and color ring tagging of Bonelli's eagle nestlings and health checking in collaboration with all partners of the project.
The results obtained so far are important, since, thanks to the surveillance and the activities of the Police task forces (Carabinieri Forestali), the population of Bonelli's eagle has significantly increased (since 2011 by almost 10% per year), counting currently about 60 occupied territories. The productivity (fledged chicks/monitored pairs) of the period 1990-2021 is 0.87 ± 0.32 and the fledging rate fledged chicks/successful pairs 1.47 ± 0.22 (n = 663). 39 chicks were tagged with GSM / GPS transmitter and the first results show interesting dispersion patterns and an unexpected quite low juvenile mortality rate (11 tagged birds were recovered dead during 2017-2021). Likewise, health checking revealed an alarming occurrence of trichomoniasis. The situation of Lanner falcon is dramatic, with a strong reduction in the population (less than 50 sites occupied in 2021) and reproductive success. The population of the Egyptian vulture is fairly stable (7-8 pairs). We also investigated the possible interaction between the Golden eagle and Bonelli's eagle in Sicily at two different spatial scales. Our results showed that the both species show different distribution patterns (Golden eagle showed clustered distribution, Bonelli's eagle close random) and select the habitat in a different and complementary way (different altitude above sea level, land use and climatic conditions). Our results also highlight significant differences in diet composition. Therefore, the probability of competition between these two species in Sicily could not be considered as a limiting factor for population dynamics.

La recuperación del águila perdicera en Catalunya: criterios de gestión y conservación"

Xavier Parellada (Servei de Fauna i Flora, Generalitat de Catalunya), Antoni Beneyto, Antoni Borau y Claudi Baiges (Institut per la Conservació dels Rapinyaires-ICRA).

Con una población estimada de 85-90 parejas en los años 70, la población catalana se desplomó durante los años 90 cayendo hasta las 65 parejas del año 2000. A partir de entones se estabilizó y inició su recuperación, alcanzando las 80 parejas en el año 2019. Sorprendentemente, los resultados del censo nacional del año 2018 mostraron que dicha recuperación era una excepción en el contexto español, pues tanto a nivel global como en buena parte de CCAA la población se encontraba en regresión.

Comprender que motivos podían justificar tendencias tan contrapuestas podría ayudar a mejorar la gestión en las regiones donde todavía se encuentra en regresión. A falta de discusión y puestas en común sobre los métodos y criterios que se aplican en las diferentes CCAA para la gestión de las poblaciones respectivas, consideramos que podíamos empezar por exponer los criterios de gestión que aplicamos en Catalunya, con sus aciertos y errores.

Para este propósito, ha sido determinante el hecho de que nos encontráramos en proceso de redacción de los criterios de gestión de dicha especie en Catalunya, una herramienta cada día más necesaria para superar la insostenibilidad de una gestión hasta ahora excesivamente centralizada por falta de personal técnico territorializado. Esperamos que el debate sobre el tema nos permita a todos corregir, enriquecer y mejorar la gestión de esta especie amenazada que tanto admiramos, y podamos con ello contribuir a conservar los hábitats mediterráneos que tan bien representa.

Accessibility of vacant sites on French territory in respect to climbing practice on cliffs

Marion Janel[1], Alain Ravayrol[1], Cécile Ponchon[2], Antoine Carrer[1]

[1] La Salsepareille, lasalsepareille@orange.fr
[2] CEN PACA, cecile.ponchon@cen-paca.org

La récente transformation de l'escalade en tant que pratique sportive de masse dans le Sud de la France soulève la problématique de l'irruption anthropique dans des espaces rupestres favorables à l'aigle de Bonelli. Pratique sportive nécessitant régulièrement la création de nouveaux itinéraires, les équipeurs exercent une pression sur les sites favorables à la nidification, qu'ils aient ou non été occupés par l'espèce, et dont la qualité peut fortement pâtir au regard de l'intensité et du développement de la pratique.
Les données GPS obtenues dans le cadre du programme de suivi télémétrique indiquent que la quasi totalité des sites vacants concernés par la pratique de l'escalade sont fréquentés de manière récurrente par des individus erratiques. Une appréhension commune des espaces rupestres, partagée entre acteurs de la conservation et promoteurs de ces pratiques de loisirs, paraît essentielle et induit une communication réciproque et l'instauration d'une relation stable dans le long terme. Les contextes locaux, les initiatives individuelles ou les perceptions des équipeurs sur le développement de leur sport et sur les enjeux de biodiversité sont à prendre en compte pour proposer des modalités de gestion des espaces, favorables à l'Aigle de Bonelli comme à l'ensemble de l'avifaune rupestre.

The recent transformation of climbing as a mass sport practice in the south of France raises the question of anthropic disturbance in cliff areas favorable to Bonelli's eagle nesting. As a sport practice requiring regularly the creation of new itineraries, climbers put pressure on nest-sites , whether or not they have been occupied by the species, and whose quality may suffer greatly in view of the intensity and development of the practice.

The GPS data obtained by the telemetric monitoring program indicate that almost all the vacant sites climbed are regularly visited by erratic individuals. A common understanding of the cliff areas, shared between nature conservationists and recreation promoters, seems essential and induces reciprocal communication and the establishment of a stable long-term relationship. The local contexts, the individual initiatives or the perceptions of the promoters on the development of their sport and on biodiversity issues are to be taken into account to propose modalities of management of the spaces, favourable to the Bonelli's Eagle as to the whole of the cliff avifauna.

Management and Conservation of the Bonelli's and Golden Eagle Populations in Israel

* OHAD HATZOFE (ohad@npa.org.il), Nature and Parks Authority, Israel. ASAF MAYROSE, University of Haifa, Israel.

During the past century, the diversity of raptors in Israel has declined drastically. Massive poisoning events, as well as electrocution on power lines, poaching and habitat destruction led to sharp declines of most if not all raptor populations. 7 out of 23 breeding raptor species became extirpated and ceased nesting well before the end of the 20th century, and 7 more species are on the verge of extinction and are currently recognized as regionally critically endangered.

The Bonelli's Eagle (*Aquila fasciata*) and the Golden Eagle (*Aquila chrysaetos*) are maybe the most impressive and iconic birds of prey still breeding in the region, with small populations that are subjected to ever intensifying risks and disturbances. The situation of these populations in Israel is even more complex, given the facts of being a tiny "island" of considerable nature conservation, surrounded by vast areas where raptors are being shot and trapped, but also considering its harsh desert climate, on the verge of these top predators' ecological requirements.

The conservation of these two eagle populations has become a very demanding task, with a number of management tools, changing from region to region and from one nesting site to the other. These include constant monitoring, nest guarding, tight coordination with civil and military aviation, electrocution mitigation and release of individuals from captive breeding nucleus. In recent years, some nesting interventions have been implemented in order to increase the breeding success, including switching of infertile eggs in natural nests with fertile eggs or chicks from captive breeding, and the ex-situ treatment of wild nestlings infected with *trichomoniasis*.

The intensive management and monitoring seem to have a gradual positive impact, with a slow increase in the number of breeding pairs and some new occupations of formerly abandoned territories. Yet the populations are very small and the high number of "mixed" pairs (adult-subadult or subadult-subadult) may indicate demographic imbalances.

Session 2

Ecologie de l'Aigle De Bonelli

Ecology of the species

Caractérisation des sites de nidification et typologie des nids de l'Aigle de Bonelli *Aquila fasciata* (Vieillot, 1822), dans les montagnes de l'Anti-Atlas occidental (Sud-ouest du Maroc)

Ali Irizi[1], Mohamed Aourir[2]* & Abdeljebbar Qninba[1]

[1] Département de Zoologie et Ecologie Animale, Institut Scientifique, Université Mohammed V, Rabat, Maroc
[2] Equipe « Biodiversité et fonctionnement des écosystèmes », Département de Biologie, Faculté des Sciences, Université Ibn Zohr, Agadir, Maroc

* Email: maourir@gmail.com

L'Aigle de Bonelli *Aquila fasciata* se reproduit dans les montagnes de l'Anti-Atlas jusqu'aux zones pré désertiques, au nord du Sahara atlantique. L'étude des caractéristiques des falaises de nidification et de la typologie des nids de l'espèce ont été menées sur une aire d'environ
29 715 km^2, durant la période 2016 -2020. Un total de 48 nids actifs, répartis sur 32 falaises à forte variation altitudinale allant de 60 à 1 890 m, ont été identifiés et leur typologie établie. De même, les paramètres biotiques (végétation dominante et diversité trophique) et abiotiques (la hauteur des nids, la nature pétrographique des falaises de nidification, leur exposition moyenne, leurs distances moyennes par rapport aux habitations, aux routes, aux pistes les plus proches) ont été utilisés pour caractériser les falaises de nidification de l'espèce, en bordure sud de son aire de répartition paléarctique.
Des analyses combinées des différents facteurs affectant la répartition de l'espèce sont indispensables pour une meilleure connaissance des exigences écologiques de l'espèce, en vue de la conservation de cette population périphérique.

Mots clés : *Aquila fasciata,* nidification, falaise, nid, Anti-Atlas, Maroc

Efecto de la altitud, tipo de nido y climatología sobre la fecha de puesta del Águila perdicera (Aquila fasciata) en la provincia de Castellón (España).

Andrés López-Peinado1* & Pascual López-López1

[1] Movement Ecology Lab, Cavanilles Institute of Biodiversity and Evolutionary Biology, University of Valencia, Valencia, Spain.

* E-mail: lopezpeinadoandres@hotmail.com

El águila perdicera (Aquila fasciata) es una especie amenazada cuyas poblaciones han disminuido alarmantemente en las últimas décadas en buena parte de su área de distribución, especialmente en la península Ibérica. Este declive poblacional es debido a múltiples factores, entre los que cabe destacar una elevada mortalidad adulta y preadulta, así como una pérdida en la productividad de las parejas territoriales. Para estudiar en profundidad este descenso en el número de pollos que cada año saltan del nido, es de vital importancia entender a fondo la dinámica de los nidos y, para ello, hay que conocer cómo las distintas variables del medio condicionan el resultado de la reproducción. Con este propósito, gracias al seguimiento de la totalidad de los territorios de cría de la especie en la provincia de Castellón (Comunidad Valenciana, España) (N = 35) durante 21 años de estudio (2000 – 2020) hemos estudiado cómo varía la fecha de puesta en función de la altitud, orientación, tipo de nido, cambio de nido con respecto al año anterior, edad de los progenitores, éxito previo y diferentes variables climatológicas (temperatura media, mínima, máxima, heladas y pluviometría) recogidas en 200 estaciones meteorológicas repartidas por todo el área de estudio. Los resultados preliminares muestran que las parejas que inician antes la reproducción obtienen una productividad mayor y que esto es consistente en el tiempo dentro de los propios territorios. La fecha media de puesta fue 18 febrero ± 13 días (rango = 24 enero – 1 abril). No se observa adelanto ni retraso en la fecha media de puesta a lo largo del periodo de estudio. Los nidos situados a menor altitud, en lugares protegidos de las inclemencias meteorológicas y cuyos progenitores eran adultos, tienen mayor probabilidad de sacar pollos adelante. Los resultados de este trabajo pueden ser de gran ayuda para la gestión del medio natural, al permitir a las autoridades conocer los periodos más sensibles para esta especie y mejorar así su conservación.

Effect of altitude, type of nest and climatology on laying date of the Bonelli's eagle (*Aquila fasciata*) in Castellón province (Spain).

Andrés López-Peinado[1]* & Pascual López-López[1]

[1] Movement Ecology Lab, Cavanilles Institute of Biodiversity and Evolutionary Biology, University of Valencia, Valencia, Spain.

* E-mail: lopezpeinadoandres@hotmail.com

The Bonelli's eagle (Aquila fasciata) is an endangered species whose populations have decreased alarmingly in recent decades in much of its range, especially on the Iberian Peninsula. This population decline is due to multiple factors, including high adult and pre-adult mortality, as well as a loss in the productivity of territorial pairs. In order to study in depth this decrease in the number of fledged chicks each year, it is important to fully understand the dynamics of the nests and, consequently, it is necessary to know how the different variables of the environment affect breeding performance. To this end, thanks to the monitoring of all the breeding territories of the species in Castellón province (Valencian Community, Spain) (N = 35) during 21 years of study (2000 - 2020) we have studied how laying date varies with altitude, orientation, type of nest, change of nest with respect to the previous year, parents age, previous success and different climatological variables (average, minimum, maximum temperature, frost and rainfall) collected in 200 meteorological stations scattered throughout the study area. Preliminary results show that pairs which start reproduction earlier obtain higher productivity rates and it is coherent over time inside territory. The average laying date was February 18 ± 13 days (range = January 24 - April 1). No advance or delay is observed in the average laying date throughout the study period. Nests located at lower altitudes, in nests protected from inclement weather and whose parents were adults, are more likely to raise chicks. The results of this work can be of great help for management, by allowing the authorities to know the most sensitive periods for this species and thus improve its conservation.

Intraspecific competition and spoliations stories

Alain Ravayrol[1], Cécile Ponchon[2], Antoine Carrer[1]

[1] La Salsepraille, lasalsepareille@orange.fr
[2] CEN PACA, cecile.ponchon@cen-paca.org

Recent demographic recovery in the French population of Bonelli's eagle is followed by an increased intraspecific competition on territorial pairs. This competition is sometimes expressed in acts which evict individuals within their territory. 34 cases have been identified, half of them detected during GPS monitoring. They concern twice as many females as males and are concentrated in a fews territories.
These territorial conflicts can lead to breeding failures, a significant turnover on certain sites, and sometimes the death of adults. They can also lead to the occupation of new territories.

Compétition intraspécifique : les cas de spoliation chez l'Aigle de Bonelli

L'amélioration des paramètres démographiques pour la population française d'Aigle de Bonelli s'accompagne d'une nette pression de compétition intraspécifique sur les territoires occupés par l'espèce. Cette compétition s'exprime parfois par des actes de spoliations des individus territoriaux. 34 cas observés, pour la moitié d'entre eux détectés dans le cadre des suivis par GPS, nous indiquent qu'elles concernent 2 fois plus de femelles que de mâles et se concentrent sur un nombre réduit de territoires.
Ces conflits territoriaux conduisent à de nombreux échecs de reproduction, un important turn over sur certains sites et parfois la mort d'adultes cantonnés. Ils peuvent également générer l'occupation de nouveaux territoires.

Efectos de la alimentación suplementaria en la reproducción y la ecología espacial del Águila perdicera (*Aquila fasciata*)

Andrés López-Peinado[1]* & Pascual López-López[1]

[1] Movement Ecology Lab, Cavanilles Institute of Biodiversity and Evolutionary Biology, University of Valencia, Valencia, Spain.

* E-mail: lopezpeinadoandres@hotmail.com

La alimentación suplementaria es una técnica ampliamente utilizada en conservación y es sabido que el incremento en la disponibilidad de comida de algunas especies ha permitido un mayor éxito reproductor de las mismas. La mayor parte de las grandes rapaces amenazadas (y muy en especial, el águila perdicera) anidan en zonas protegidas, donde establecen parte de sus territorios de caza. Sin embargo, la mayor parte de su mortalidad ocurre fuera de estas áreas, ya que las abandonan para cazar fuera de ellas. Esto puede deberse a la ausencia de presas suficientes dentro de las áreas protegidas, por lo que realizamos un experimento con seis parejas cuyos territorios englobaban parte de las áreas protegidas de Castellón (Comunidad Valenciana, España). Para ello, se llevó a cabo una alimentación suplementaria dos veces por semana durante el periodo de Diciembre a Junio de los años 2018 y 2019, con dos objetivos: comprobar la mejora de la productividad en dichas parejas y comprobar una reducción del tamaño de su área de campeo (K95), una mayor eficacia del uso de su territorio (menor ratio K50/K95) y una mayor proporción de superficie protegida en su área de campeo. Los resultados muestran que la disponibilidad de alimento es un factor limitante en los territorios estudiados y que la alimentación suplementaria ha incrementado la productividad de los mismos. Los meses en los que han dispuesto de alimentación suplementaria han reducido sus áreas de campeo, incrementando la eficiencia de uso de su territorio y reduciendo la proporción de superficie no protegida que incluyen en su territorio.

Effects of supplementary feeding on breeding performance and spatial ecology of Bonelli's eagle (*Aquila fasciata*)

Andrés López-Peinado[1]* & Pascual López-López[1]

[1] Movement Ecology Lab, Cavanilles Institute of Biodiversity and Evolutionary Biology, University of Valencia, Valencia, Spain.

* E-mail: lopezpeinadoandres@hotmail.com

Supplementary feeding is a widely used technique in conservation and it is known that the increased availability of food for some species has led to greater reproductive success. Most endangered large birds of prey (especially Bonelli's Eagles) nest in protected areas, where they establish part of their hunting territories. However, most of their mortality occurs outside these areas, as they abandon them to hunt outside. This may be due to the absence of sufficient prey within the protected areas, so we conducted an experiment with six pairs whose territories included part of the protected areas of Castellón (Valencian Community, Spain). For this purpose, supplementary feeding was carried out twice a week during the period from December to June 2018 and 2019, with two objectives: to test the improvement of productivity in these pairs and to verify a reduction in the size of their home range (K95), a higher efficiency of their territory use (lower K50/K95 ratio) and a higher proportion of protected area in their home range. The results show that food availability is a limiting factor in the territories studied and that supplementary feeding has increased their productivity. The months in which supplementary feeding has been available have reduced their roosting areas, increasing the efficiency of their territory use and reducing the proportion of unprotected area included in their territory.

Juvenile dispersal of Bonelli's eagle in France: first results and perspectives

Cécile Ponchon[1], Alain Ravayrol[2], Antoine Carrer[2]

[1] CEN PACA, cecile.ponchon@cen-paca.org

[2] La Salsepareille, lasalsepareille@orange.fr

From 2017 to 2021, 70 juveniles of Bonelli's eagles were marked with GPS tags in France to study juvenile dispersal, the causes of mortality and also possibly the settlement processes.
First results show a random dispersal from north to south, with a slight propensity for young eagles born on the west bank of the Rhône river to explore further.
The Crau/Camargue area remains the main dispersal areas; the extreme explorations lead eagles to northern Algeria in the south, Denmark in the north and Poland in the east.
The main cause of mortality remains electrocution, with poaching coming in second place.
The early stages of settlement have been observed for 3 immatures.
Further analysis of the data set will allow us to explore habitat selection during the dispersal period, intraspecific competition, to mesure effect of birthplace on dispersal or exploration of potential or vacant nesting sites.

Dispersion des Aigles de Bonelli juvéniles en France : premiers résultats et perspectives

De 2017 à 2021, 70 Aigle de Bonelli juvéniles ont été équipés de balises GPS en France afin d'étudier la dispersion des juvéniles, les causes de mortalité et éventuellement les processus de cantonnement.
Les premiers résultats montrent une dispersion aléatoire du nord au sud, avec une légère propension des jeunes aigles nés sur la rive ouest du Rhône à explorer davantage.
La zone Crau/Camargue reste la principale zone d'erratisme ; les explorations extrêmes conduisent les aigles vers le nord de l'Algérie au sud, le Danemark au nord et la Pologne à l'est.
La principale cause de mortalité reste l'électrocution, le braconnage arrivant en deuxième position.
Les prémices de cantonnement ont pu être observées pour 3 immatures.
Une analyse plus approfondie de l'ensemble des données nous permettra d'explorer la sélection de l'habitat pendant la période d'erratisme, la compétition intraspécifique, de mesurer l'effet du site de naissance sur la dispersion ou l'exploration de sites de nidification potentiels ou vacants.

Session 3

Actions de conservation

Conservation actions

Assessing human disturbance to Bonelli's eagles using GPS/GSM dataloggers before and after COVID-19 lock-down in Spain

ARTURO M. PERONA, Movement Ecology Lab (Cavanilles Institute of Biodiversity and Evolutionary Biology. University of Valencia) Valencia, Spain.

VICENTE URIOS, Vertebrates Zoology Research Group, University of Alicante, Alicante, Spain

JUAN JIMÉNEZ, Servicio de Vida Silvestre, Conselleria de Agricultura, Desarrollo Rural, Emergencia Climática y Transición Ecológica, Generalitat Valenciana, Valencia, Spain.

PASCUAL LÓPEZ-LÓPEZ, Movement Ecology Lab (Cavanilles Institute of Biodiversity and Evolutionary Biology. University of Valencia) Valencia, Spain.

The use of biologging technologies has changed our way to analyze and understand the animal ecology. Animal tracking data provide a broader understanding on how individuals respond to interaction with other individuals of the same or different species, including the human beings. Thereby, human-wildlife conflicts are of important concern in conservation biology as more of these conflicts are expected to happen as a consequence of increasingly human intensive pressure over natural areas. The temporal pattern of occupation of natural areas for recreation is changing, resulting in an ever-increasing concentration of people during weekends and holidays, in the so-called "weekend effect". In the past, we analyzed the response to disturbance of 30 Bonelli's eagles tracked by high-frequency GPS/GSM telemetry and computed daily home-ranges throughout the annual cycle considering Kernel Density Estimators (KDE), appointing that eagles had to increase their ranging effort during weekends and holidays. However, what could happen if there are no human beings there anymore? Taking advantage of the COVID-19 issued lock-down in Spain we made use of GPS/GSM dataloggers with a tri-axial accelerometer, to test the ranging effort and Overall Dynamic Body Acceleration, as a measure of energy expenditure, to assess differences in behavior before and after the lock-down. In an exploratory analysis, during the later period, eagles seem to shrink the daily distance and energy expenditure as well as the "weekend effect" seems to be vanishing. Results are yet to be confirmed but preliminary analyses seem promising, highlighting the effect of human activities on wildlife behavior.

Do GPS transmitters affect adult survival?

Roger Pradel, CEFE CNRS, roger.pradel@cefe.cnrs.fr

In order to recognize individual animals for monitoring purposes in the wild, there is often a need to put some identification tag on them. A common concern with this procedure is that the ID tag may influence the animal in undesirable ways. Although traditional metal rings are generally considered neutral on birds, colour rings have for instance been sometimes reported as interfering with pair matching.

In France, starting in 2009, some Bonelli eagles have been equipped with GPS transmitters. To date, we have at our disposal the capture histories of 119 territorial individuals between 2006 and 2020, of which 46 have been equipped with GPS for at least some years during this period. 11 GPS-equipped individuals have been found dead versus 2 non GPS individuals, which may raise concern about the benignity of the device. Yet, corpses with functional GPS are found systematically.

To properly analyse the potential effect of carrying a GPS, we endeavour a capture-recapture analysis that accounts for detectability. Detectability further depends on the presence or not of metal and colour rings. Hence, we need to account for changes in the equipment of individuals upon physical capture and device failures (ring loss, GPS failure).

Assessing the effects of permanent emigration on survival and population viability in territorial raptors: the case of the Bonelli's eagle

Jaume-Adria Badia-Boher*[1], Joan Real[1], Francesc Parès[1], & Antonio Hernández-Matías[1]

[1]Grup de Biologia de la Conservació, Departament de Biologia Evolutiva, Ecologia i Ciències Ambientals, Universitat de Barcelona (UB), Barcelona , Catalonia, Spain.

**jabadia@ub.edu*

Robust estimates of survival are key to evaluate the dynamics and conservation status of populations. Survival is usually estimated using capture-mark-recapture analyses, but most study designs and modelling frameworks cannot distinguish between mortality and emigration from the study area. This can be especially important in territorial raptors, as tagging usually is focused on fledglings that may move far away from their birthplaces to breed and not return to the study area throughout their lives. This phenomenon - known as permanent emigration - can lead to negatively biased estimates of survival, and consequently, wrong assumptions of the study population's status, which can ultimately lead to implementing ineffective conservation actions. Here, we took advantage of a long-term intensive ringing and monitoring scheme on the regionally threatened Bonelli's eagle (Aquila fasciata) conducted in Catalonia. We also considered data of eagles born in Catalonia and recruited in neighbouring populations of the Iberian Peninsula and France, thanks to simultaneous monitoring schemes in these areas. Such a degree of detail in the monitoring of contiguous populations is infrequent in most species and provides an excellent opportunity to estimate permanent emigration. We applied multistate capture-recapture methods to quantify the magnitude of permanent emigration in the population and assess its potential bias on survival estimation. In addition, we developed an individual-based population model to evaluate the potential implications of this bias on population viability predictions. Our results illustrate that omitting permanent emigration may lead to an underestimation of survival and skewed population predictions. Overall, we highlight the need to improve our understanding of permanent emigration in capture-recapture studies and to develop robust methods to account for this potential source of bias.

Le fonctionnement démographique de la population française d'Aigle de Bonelli : une mise à jour

Aurélien Besnard[1], Olivier Scher[2], Patrick Boudarel[3], Cécile Ponchon[4], Alain Ravayrol[5], Nicolas Lieury[1] and Alexandre Millon[6]

[1] CEFE CNRS, Aurelien.BESNARD@cefe.cnrs.fr

[2] CEN Occitanie, [3] Dreal Occitanie, [4] CEN PACA, [5] La Salsepareille, [6] IMBE

La population française d'aigle de Bonelli a subi un déclin majeur de ses effectifs entre les années 1960 et les années 2000 passant d'un effectif estimé de 80 couples à 22 couples en 2002. Les actions de préservation de l'espèce menées depuis les années 1980 avaient pour objectif d'améliorer le statut de conservation de l'espèce à travers des actions comme l'isolation des lignes électriques ou la protection des falaises d'une trop forte fréquentation. Les travaux de recherche menés sur la démographie de l'espèce il y a une dizaine d'année ont permis de démontrer que le traitement des lignes électriques dangereuses depuis la fin des années 1990 a fortement contribué à améliorer la situation de la population française. En effet, avant cette période, 90% des jeunes aigles nés en France mourraient électrocutés avant même d'atteindre l'âge de première reproduction. L'amélioration forte de la survie de toutes les classes d'âge suite aux travaux d'isolation avait permis de remonter le taux de croissance local à 0.96 sur la décennie 2000-2010. Sur cette même période, le taux de croissance observé était de 1.02 et la différence avec le 0.96 prédit par des modèles démographiques s'expliquait par une immigration régulière d'environ 6-7 individus par an en provenance d'Espagne. L'objet du travail présenté ici était de mettre à jour les connaissances sur la dynamique de la population en France en comparant les paramètres démographiques des dix dernières années avec ceux des deux décennies précédentes. A l'aide d'un modèle intégré de population, nous montrons que la survie des individus juvéniles et immatures s'est encore sensiblement améliorée sur la dernière décennie même si cet effet n'est pas statistiquement significatif. La survie des adultes était déjà forte et n'a pas changé par rapport à la décennie précédente. La fécondité semble aussi s'être légèrement améliorée. Ces améliorations des paramètres démographiques font que le taux de croissance local est désormais de 0.99, ce qui suggère que la population pourrait maintenant se maintenir même en l'absence d'immigration. L'immigration est toujours présente mais l'amélioration des paramètres démographiques locaux font qu'elle contribue aujourd'hui moins à la croissance observée que le recrutement local. Nos travaux montrent aussi que l'espèce subit toujours des mortalités par électrocution, en dehors des domaines vitaux des couples et donc concentrées sur les juvéniles et immatures. Le suivi GPS de juvéniles montre que ces électrocutions interviennent à large échelle, parfois en dehors de la zone méditerranéenne, ce qui implique de développer une nouvelle approche pour continuer à les réduire sur le moyen-long-terme.

The demographic functioning of Bonelli's eagle French population: an update

Aurélien Besnard[1], Olivier Scher[2], Patrick Boudarel[3], Cécile Ponchon[4], Alain Ravayrol[5], Nicolas Lieury[1] and Alexandre Millon[6]

[1] CEFE CNRS, Aurelien.BESNARD@cefe.cnrs.fr

[2] CEN Occitanie, [3] Dreal Occitanie, [4] CEN PACA, [5] La Salsepareille, [6] IMBE

The French population of Bonelli's eagle has suffered a major decline in numbers between the 1960s and the 2000s from an estimated 80 pairs to 22 pairs in 2002. The preservation actions carried out since the 1980's aimed at improving the conservation status of the species through actions such as the insulation of power lines or the protection of cliffs from too much frequentation. Research work carried out on the demography of the species about ten years ago has shown that the treatment of dangerous power lines since the end of the 1990s has greatly contributed to improve the situation of the French population. Indeed, before this period, 90% of the young eagles born in France died of electrocution before reaching the age of first reproduction. The strong improvement of the survival of all age classes following the isolation works had allowed to raise the local growth rate to 0.96 over the decade 2000-2010. Over the same period, the observed growth rate was 1.02 and the difference with the 0.96 predicted by demographic models was explained by a regular immigration of about 6-7 individuals per year from Spain. The purpose of the work presented here was to update the knowledge of the population dynamics in France by comparing the demographic parameters of the last ten years with those of the two previous decades. Using an integrated population model, we show that the survival of juveniles and immature individuals has improved significantly over the last decade even if this effect is not statistically significant. Adult survival was already strong and did not change from the previous decade. Fertility also appears to have improved slightly. These improvements in demographic parameters mean that the local growth rate is now 0.99, suggesting that the population could now be sustained even without immigration. Immigration is still present but the improvement in local demographic parameters means that it now contributes less to the observed growth than local recruitment. Our work also shows that the species still suffers mortality by electrocution, outside the home ranges of the pairs and therefore concentrated on juveniles and immatures. GPS monitoring of juveniles shows that these electrocutions occur on a large scale, sometimes outside the Mediterranean area, which implies the development of a new approach to continue to reduce them in the medium-long term.

Impacto de los parques eólicos sobre el águila perdicera en Catalunya. Experiencias de gestión

Xavier Parellada (Servei de Fauna i Flora, Generalitat de Catalunya)

A mediados de los años 90 el auge de la energía eólica empezó a afectar el hábitat del águila perdicera en Catalunya. La coincidencia de la construcción de un parque eólico con el abandono de un territorio de águila perdicera levantó la alarma, pues los indicios apuntaban a que la implantación de nuevos parques podía suponer un nuevo factor de amenaza a sumar a los ya conocidos que, como las líneas eléctricas, la persecución o la destrucción del hábitat, ya estaban causando la regresión de su población.

Los resultados de los primeros estudios de radioseguimiento de parejas afectadas por parques eólicos, y la no detección de accidentes por colisión con las aspas de los aerogeneradores, nos llevó al convencimiento de que el principal impacto generado por estas centrales energéticas a la especie era el efecto vació sobre su hábitat. A partir de dicha constatación, la evaluación de los nuevos proyectos que afectaban sus territorios se ha basado en determinar la gravedad de la pérdida potencial de hábitat, y en considerar incompatible la ubicación de aerogeneradores en sectores del área de campeo considerados importantes para la supervivencia de la pareja.

En esta exposición expondremos varios ejemplos de los casos más relevantes estudiados, y presentaremos los protocolos y criterios que aplicamos para su evaluación.

Impact des parcs éoliens sur les aigles de Bonelli en Catalogne en Catalogne. Expériences de gestion

Xavier Parellada (Servei de Fauna i Flora, Generalitat de Catalunya)

Au milieu des années 1990, l'essor de l'énergie éolienne a commencé à affecter l'habitat de l'aigle de Bonelli en Catalogne. La coïncidence de la construction d'un parc éolien avec l'abandon d'un territoire d'aigle de Bonelli a tiré la sonnette d'alarme, car tout porte à croire que l'implantation de nouveaux parcs pourrait représenter un nouveau facteur de menace à ajouter à ceux déjà connus, tels que les lignes électriques, la persécution ou la destruction de l'habitat, qui entraînent déjà la régression de sa population.

Les résultats des premières études de suivi télémétrique des couples affectés par les parcs éoliens, et la non-détection d'accidents dus à des collisions avec les pales des éoliennes, nous ont amenés à la conviction que le principal impact généré par ces centrales sur l'espèce était l'effet d'abandon de son habitat. Sur la base de ce constat, l'évaluation des nouveaux projets affectant leurs territoires a été basée sur la détermination de la gravité de la perte potentielle d'habitat, et sur le fait de considérer comme incompatible l'implantation d'éoliennes dans des secteurs de reproduction considérés comme importants pour la survie du couple.

Dans cette présentation, nous donnerons plusieurs exemples des cas les plus pertinents étudiés, et nous présenterons les protocoles et les critères que nous appliquons pour leur évaluation.

Session 4

Évaluation des actions de renforcement et de réintroduction

Assessment of the reinforcement and reintroduction actions

Bonelli's Eagle population settlement and overall results of AQUILA a-LIFE Project. Movements between subpopulations and identified threats

Authors: Juan José Iglesias, Ernesto Álvarez, Manuel Galán, Pablo Izquierdo, Sergio de la Fuente, Juan Pablo Díaz y Carlota Viada.

The AQUILA a-LIFE Project (LIFE16 NAT/ES/000235) aims to increase the presence of Bonelli's Eagle in western Mediterranean and reverse the regressive trend of its population. The project is working on the recovery of the species over an extensive geographic area at metapopulation scale.
To accomplish this goal, the release of individuals is being carried out, following a new methodology whose effectiveness has been previously demonstrated in the Life Bonelli Project. These releases are made in Madrid, Navarra and Alava, where we have already obtained positive results, and in Sardinia. In fact, the AQUILA a-LIFE project could be seen as the continuation of the LIFE Bonelli project.
Another essential work line of the project is to tackle the main threats for the species, with special efforts in preventing and reducing death by electrocution, through joint work with key sectors such as electricity companies, local administrations and experts in this field.
Bonelli's eagle shares its main threats with other species of birds of prey such as the Spanish Imperial Eagle, the Golden Eagle or the Short-toed Eagle, among others, so they will also benefit from the project's actions.
This paper resume the obtained results on releasing individuals; dispersal juvenile areas, number of established pairs and the actions developed in order to decrease mortality. In summary, there are, at least, 17 new territories since the beginning of the LIFE Bonelli Project (2013) until now (2020); nine in Mallorca, four in Madrid, two in Alava and two in Navarra. The most important dispersal areas has been identified in the Iberian Peninsula, such as the north of the province of Toledo, where almost all the released eagles in central and northern Spain have visited, and the south of the province of Seville for the andalusian population.
Among the works aimed to reduce mortality, until the end of 2019 more than 1,200 dangerous electrical pylons have been retrofitted within the scope of the Project. At the same time, capacity training courses on electrocution have been carried out, targeted to electric companies' staff, government technicians, environmental agents, engineers, etc. We are currently in the process of publishing a "White Book" about the problem of electrocution in Spain.

AQUILA a-LIFE Project
Website: https://aquila-a-life.org
Contact person: **Manuel Galán** (General Coordinator) manu@grefa.org

Entity: **GREFA**

Does the Release of Bonelli's Eagles (*Aquila fasciata*) From Captive Breeding Nucleus Contribute to Population Rehabilitation?

* ASAF MAYROSE (asafmayrose96@gmail.com), University of Haifa, Israel. OHAD HATZOFE, Nature and Parks Authority, Israel. NIR SAPIR, University of Haifa, Israel.

The Bonelli's Eagle was a common resident throughout Israel until the late 1960s, when about half of its population was decimated by secondary poisoning. The decline continued during the following decades due to electrocution, illegal nest harvesting disturbances at breeding sites and other mortality factors, and brought the population in Israel, and probably elsewhere in the Middle-East, to the brink of extinction. A rehabilitation program set in 2000 included few measures, among them the release of juvenile eagles from captive breeding nucleus. Since 2003, this nucleus is producing two to seven eaglets yearly.

There is only little evidence for the recruitment of captive-born eagles into the wild population, and their contribution to its growth is unclear. Yet, in recent years there is an apparent increase in the number of Bonelli's eagle pairs breeding in the wild, including the reoccupation of territories that were abandoned for many years.

A telemetry study was recently initiated to examine these subjects by comparing dispersal patterns and survival rates of captive-born versus nature-born eagles. The results from the first two years of study show significant differences between these two groups, with captive born eagles dispersing much farther away from their natal sites (mean maximum distance of 1,280 km, N=11) compared to the dispersal of nature-born eagles (mean maximum distance of 300 km, N=9). The different dispersal patterns may be the reason for the lower survival rates exhibited by the captive born eagles, as many of them wander to neighboring countries, with poor conservation status. Moreover, these birds also have a higher tendency to being electrocuted on power lines.

Genetic analysis and alteration of the releasing methods are being used in order to check whether the different movement and behavior attributes of captive-born eagles are linked to genetic properties or behaviorally mechanisms during their growth.

Captive breeding of Bonelli's eagles as a conservation tool. A combined effort

Pablo Izquierdo[1], Christian Pacteau[2], Rebeca García[1], Ernesto Álvarez[1], Manuel Galán[1], Juan José Iglesias[1] y Juan Pablo Díaz[1]

[1]GREFA

[2]UFCS-Vendée

Captive breeding of endangered species has been proven to be an esential tool for ex situ conservation all across the globe. Regarding the birds of prey, as a key avian group in ecosystems, captive breeding of releasable individuals is a valuable conservation resource.

During two consecutive LIFE programs involving the Bonelli's Eagle (LIFE Bonelli and AQUILA a-LIFE), the release of captive-bred bonelli's eagles has been one of the keystones to restore the ancient bonelli's eagles' populations in the mediterranean area.

Nonetheless, captive breeding of this particular species is a complex task. To achieve this challenge, a total of three centers attempted reproduction with the species following different methodologies and breeding 10-16 birds per year. Although some of the methodologies are different among centers, removal of clutches, artificial incubation and hand-rearing have been common ground.

The captive-bred individuals over the years have been capable of thrive in the wild, being this the main goal of the captive breeding network.

AQUILA a-LIFE Project

Website: https://aquila-a-life.org

Contact person: **Manuel Galán** (General Coordinator) manu@grefa.org

Entity: **GREFA**

Onset of dispersal of juvenile Bonelli's Eagle (*Aquila fasciata*) in Mediterranean islands: a comparison of wild and reintroduced individuals.

OLGA EGEA-CASAS*[1], ERNESTO ÁLVAREZ[2], GIUSEPPE CORTONE[3], JUAN DALMAU[2], MASSIMILIANO DI VITTORIO[3], MANUEL GALÁN[2], JUAN JOSÉ IGLESIAS[3], MARIO LO VALVO[4], STEFANIA MERLINO[3], CARLOTA VIADA[5], PASCUAL LÓPEZ-LÓPEZ[1]

[1]Movement Ecology Lab, Cavanilles Institute of Biodiversity and Evolutionary Biology, University of Valencia, Valencia, Spain.
[2] Grupo de Rehabilitación de la Fauna Autóctona y su Hábitat (GREFA), Madrid, Spain.
[3] Ecologia Applicata Italia, Termini Imerese (PA), Italy.
[4] Laboratorio di Zoologia applicata, Dipartimento di Scienze e Tecnologie Biologiche, Chimiche e Farmaceutiche, University of Palermo, Palermo, Italy.
[5] COFIB-Servei de Protecció d'Espècies, LIFE Bonelli. Govern de les Illes Balears.

The development of advanced technologies for wildlife tracking has led to rediscover certain aspects of ecology, especially when it concerns animal movement and behavior. Here, we use GPS/GSM telemetry to track juvenile Bonelli's eagle (*Aquila fasciata*) during their post-nestling dependence period in island environments. This technology allows an accurate monitoring, increasing our current knowledge about the biology of this endangered species. The Bonelli's eagle is a threatened species throughout Europe, especially in Italy and Spain. The wild population in Italy is limited to Sicily, where conservation actions are being implemented. In Spain the species shows a wider distribution, although most of its territories have been lost, particularly in the Balearic Islands were the species became extinct in the second half of the 20th century. The juvenile dispersal period is crucial for occupying new territories and for population dynamics. Here, we analyzed the behavior of 47 GPS-tracked juvenile Bonelli's eagles that were tagged at nest from 2011 to 2019. We compared movements from reintroduced individuals and first generation of reintroduced chicks from Mallorca (Spain) along with wild chicks from Sicily (Italy). According to the movement parameters (i.e. age of first flight, age of dispersal, residence time and number of revisits to the nest or release site) we found significant differences in the number of revisits to the nest due to the origin of the individual: wild individuals made the highest amount of revisits (59,87 ± 49,61) followed by the first generation after reintroduction in Mallorca (23,29 ± 22,09) and being the reintroduced the ones that made the lesser number of visits (17,94 ± 25,73). We also found significant differences in the onset of dispersal age: the earliest were wild individuals (153,87 ± 17,45 days), followed by the first generation after reintroduction (163,86 ± 6.2 days) and finally the reintroduced individuals were the eldest at the onset of dispersal (167,29 ± 22,61 days). This occurs probably because parents force their chicks to disperse. No significant differences were found for the remaining parameters. Regardless of the chick's origin, males and females did not show significant differences in any of the parameters, showing almost identical behavior. Finally, our results show that juvenile Bonelli's eagles display enough behavioral plasticity to conduct successful reintroduction programs without losing the natural behavior of the species.

Cost-effectiveness evaluation of reintroduction strategies in the Bonelli's eagle population in Mallorca island

Jaume-Adria Badia-Boher*[1], Antonio Hernández-Matías[1], Carlota Viada[2], & Joan Real[1]

[1]Grup de Biologia de la Conservació, Departament de Biologia Evolutiva, Ecologia i Ciències Ambientals, Universitat de Barcelona (UB), Barcelona , Catalonia, Spain.

[2]LIFE Bonelli, Govern de les Illes Balears – COFIB, Palma de Mallorca, Balearic Islands, Spain

*jabadia@ub.edu

Reintroductions are becoming a popular tool to prevent extinctions, although their overall success rate is low. Assessing the efficiency and cost-effectiveness of different reintroduction strategies may help identify and promote efficient practices. Captive-breeding is widely used in animal reintroductions, although concerns have been raised about relatively high failure rates and economic costs. Here, we compared the effectiveness of two simultaneously used strategies in the reintroduction of the Bonelli's eagle on the island of Mallorca: The release of captive-bred chicks and wild-reared, translocated non-juveniles. To do so, we estimated the main vital rates for individuals released by both strategies and used these to perform population simulations to assess their overall performances. The use of wild-reared non-juveniles showed a trend with higher numbers of breeding pairs 10 years after the end of releases (14.75 pairs, 95% CI 4–25 vs. 11.21 pairs, 95% CI 2–24) and was the only strategy that prevented extinction in the long term. Following that, based on cost estimations of every strategy and different reintroduction budgets, we assessed the cost-effectiveness of releasing wild-reared non-juveniles compared with two captive-breeding alternatives: Releasing chicks either originally from breeding programmes or extracted from nests in natural populations. Again, releasing wild-reared non-juveniles was the only strategy that prevented long-term extinction in all economic scenarios (i.e. low-budget scenario 21.49 pairs, 95% CI 2–25). The use of chicks sourced from captive-breeding programmes did not guarantee long-term persistence even in high-budget scenarios (14.50 pairs, 95% CI 0–25). Releasing wild-reared non-juveniles boosts early recruitment to the breeding population and early reproduction, which can be key for reintroduction success. However, in some scenarios, post-release effects can be stronger in wild-reared individuals, especially because of high translocation stress and post-release dispersal. Hence, we recommend undertaking careful evaluation of the pros and cons of every strategy and embracing adaptive management to choose best strategies.

Session 5

Des causes de mortalité toujours présentes

Causes of mortality are still present

When necessary data are missing: threat collection protocol for Bonelli's eagle

Afroditi Kardamaki[1], Elisavet Georgopoulou[1], Giannis Kontogeorgos[1], Stavros Xirouchakis[1]

[1] Natural History Museum of Crete, University of Crete, University Campus (Knossos), Herakleion 71409, Crete, Greece

One of the conservation actions set on the Bonelli eastMed project which is taking place in Greece and Cyprus is to reduce direct mortality through infrastructure interventions. However, in order to implement what had been designed, we needed to identify all human-related threats towards Bonelli's eagles. Electrocution and collision with power lines, as well as drowning in artificial water reservoirs and open irrigation tanks though in a lesser extent, are ranking very high as mortality factors for big raptors. To this day, data relevant to the Greek national power grid and the dangerous water infrastructure for the avifauna are non-existent in Greece, which necessitated the development of cost-effective ways of gathering such information. Based on our knowledge of Bonelli's eagle territorial behaviour, a 4km buffer zone around the active nest was selected as our area of interest. We used satellite images for our preliminary data collection which were afterwards validated or rejected during fieldwork. Finally, all these records along with new field observations were reprocessed and stored into our ArcGIS database and became ready-to-use for sensitivity mapping.

Keywords: power lines, collision, electrocution, artificial water reservoirs

Home range size and mortality risks of territorial Bonelli's eagle (*Aquila fasciata*) tracked by high-resolution GSM/GPS telemetry in Spain

Pascual López-López[1], Arturo M. Perona[1], Vicente Urios[2]

[1] Movement Ecology Lab, Cavanilles Institute of Biodiversity and Evolutionary Biology, University of Valencia, Valencia, Spain.

[2] Vertebrates Zoology Research Group, Departament of Environmental Sciences and Natural Resources, University of Alicante, Alicante, Spain.

* E-mail: Pascual.Lopez@uv.es

Tracking technologies have facilitated dramatic advances in the fundamental understanding of ecology and animal behaviour. In this presentation we will show the results of a current GPS tracking project of territorial Bonelli's eagles in Eastern Spain started in 2015. The Bonelli's eagle is a long-lived endangered species in Europe which main threats include high mortality due to electrocution, collision with power lines and direct persecution (i.e., mainly poisoning and shooting). Thanks to high-resolution GSM/GPS telemetry we have obtained more than 45 million GPS locations of 51 different individuals of 23 breeding pairs. All individuals are territorial breeding birds, including 15 subadults (2 – 3 years) and 36 adults (≥ 4 years old). Home range areas were larger than those previously reported using conventional radio-tracking. Home range size was smaller during the breeding season than during the non-breeding season. Eagles are resident throughout the year, showing strong territorial behaviour and site fidelity. Our results show that males and females spent most of their time together as a consequence of cooperative hunting behaviour. Occasionally, eagles made long-distance movements (i.e., "excursions") both during the breeding and non-breeding season. During these excursions, which span between a few hours up to two or three days, birds flew over other neighbouring territories probably to explore new potential mates and even visited juvenile dispersal areas. Space use varied considerably within the home range and remarkably, places located far from nesting sites were used more frequently than some areas located close to the nest. Therefore, traditional conservation measures based on defining restrictive rules within a fixed radius around nesting sites are biologically meaningless if other areas within the home range are not protected too. In our case, although most pairs place their nests within NATURA 2000 protected areas, daily home range movements extend beyond their limits, thereby increasing mortality risks mainly with man-made artificial infrastructures. In fact, overall 20 birds have been found dead since the beginning of the project (≈40% of all tracked birds). This unnatural high adult mortality, mainly caused by poisoning and electrocution, could explain the decline documented in our study area in the latest two decades.

Tamaño del área de campeo y riesgos de mortalidad de águilas perdiceras (*Aquila fasciata*) territoriales seguidas mediante telemetría GPS/GSM de alta resolución en España

Pascual López-López[1], Arturo M. Perona[1], Vicente Urios[2]

[1] Movement Ecology Lab, Cavanilles Institute of Biodiversity and Evolutionary Biology, University of Valencia, Valencia, Spain.
[2] Vertebrates Zoology Research Group, Departament of Environmental Sciences and Natural Resources, University of Alicante, Alicante, Spain.

* E-mail: Pascual.Lopez@uv.es

Las tecnologías de seguimiento han facilitado grandes avances en los campos de la ecología y el comportamiento animal. En esta comunicación, mostraremos los resultados de un proyecto actual de seguimiento mediante GPS de águilas perdiceras territoriales en el este de España iniciado en 2015. El águila perdicera es una especie longeva en peligro de extinción en Europa cuyas principales amenazas incluyen una elevada mortalidad debido a electrocución, colisión con líneas eléctricas y persecución directa (i.e., envenenamiento y tiroteo). Gracias a la telemetría GSM/GPS de alta resolución hemos obtenido más de 45 millones de localizaciones GPS de 51 individuos diferentes de 23 parejas reproductoras. Todos los individuos son aves reproductoras territoriales, que incluyen 15 subadultos (2 - 3 años) y 36 adultos (≥ 4 años). Las áreas de campeo obtenidas fueron mayores que las descritas previamente mediante radio-tracking convencional. El tamaño del área de campeo fue menor durante la época de cría que fuera de ésta. Las águilas son residentes durante todo el año, mostrando un fuerte comportamiento territorial y fidelidad a su territorio. Nuestros resultados muestran como machos y hembras pasan la mayor parte de los tiempos juntos como consecuencia del comportamiento cooperativo de caza. Ocasionalmente, las águilas realizaron movimientos de larga distancia (i.e., "excursiones") tanto durante la época de cría como fuera de ésta. Durante estas excursiones, que se extendieron desde unas pocas horas hasta dos o tres días, las águilas sobrevolaron otros territorios vecinos probablemente para explorar posibles nuevas parejas de cría, visitando incluso áreas de dispersión juvenil. El uso del espacio varió considerablemente dentro del área de campeo y, remarcablemente, zonas ubicadas lejos de los lugares de nidificación fueron visitados con mayor frecuencia que algunas áreas ubicadas cerca del nido. Por lo tanto, las medidas de conservación tradicionales basadas en el establecimiento de medidas restrictivas dentro de un radio fijo alrededor de los lugares de nidificación carecen de sentido biológico si otras zonas dentro del área de campeo no se protegen también. En nuestro caso, aunque la mayoría de las parejas ubican sus nidos dentro de espacios protegidos dentro de la red NATURA 2000, los movimientos diarios se extienden más allá de sus límites, lo que aumenta los riesgos de mortalidad principalmente con infraestructuras artificiales. De hecho, han muerto en total 20 águilas desde el comienzo del proyecto (≈40% de todas las aves marcadas). Esta elevada mortalidad adulta no natural, causada

principalmente por envenenamiento y electrocución, podría explicar el declive observado en nuestra área de estudio en las últimas dos décadas.

Taille du domaine vital et risques de mortalité des aigles de Bonelli (Aquila fasciata) territoriaux suivis par télémétrie GPS/GSM en Espagne

Pascual López-López[1], Arturo M. Perona[1], Vicente Urios[2]

[1] Movement Ecology Lab, Cavanilles Institute of Biodiversity and Evolutionary Biology, University of Valencia, Valencia, Spain.
[2] Vertebrates Zoology Research Group, Departament of Environmental Sciences and Natural Resources, University of Alicante, Alicante, Spain.

* E-mail: Pascual.Lopez@uv.es

Les technologies de télémétrie ont permis de grandes avancées dans les domaines de l'écologie et du comportement animal. Dans cette présentations, nous montrerons les résultats d'un projet actuel de suivi GPS d'aigles de Bonelli territoriaux dans l'est de l'Espagne, initié en 2015. L'aigle de Bonelli est une espèce menacée qui vit depuis longtemps en Europe et dont les principales menaces sont la mortalité élevée due à l'électrocution, la collision avec les lignes électriques et la persécution directe (c'est-à-dire l'empoisonnement et le tir). Grâce à la télémétrie GSM/GPS haute résolution, nous avons obtenu plus de 45 millions de localisations GPS de 51 individus différents issus de 23 couples reproducteurs. Tous les individus sont des oiseaux nicheurs territoriaux, dont 15 subadultes (2 - 3 ans) et 36 adultes (≥ 4 ans). Les domaines vitaux obtenus étaient plus grands que ceux décrits précédemment par radiopistage conventionnel. La taille du domaine vital était plus petite pendant la saison de reproduction qu'en dehors de celle-ci. Les aigles résident toute l'année et font preuve d'un fort comportement territorial et d'une grande fidélité au territoire. Nos résultats montrent que les mâles et les femelles passent la plupart de leur temps ensemble en raison d'un comportement de chasse coopératif. À l'occasion, les aigles effectuent des déplacements sur de longues distances (cad des " excursions ") pendant et en dehors de la saison de reproduction. Au cours de ces excursions, qui ont duré de quelques heures à deux ou trois jours, les aigles ont survolé les territoires voisins, probablement pour explorer d'éventuels nouveaux couples reproducteurs, et ont même visité des zones de dispersion des juvéniles. L'utilisation de l'espace varie considérablement au sein de la zone de reproduction et, de manière remarquable, les zones situées loin des sites de nidification ont été visitées plus fréquemment que certaines zones situées à proximité du nid. Par conséquent, les mesures de conservation traditionnelles basées sur l'établissement de mesures restrictives dans un rayon fixe autour des sites de nidification n'ont aucun sens sur le plan biologique si d'autres zones de la zone de reproduction ne sont pas également protégées. Dans notre cas, bien que la plupart des couples ont installé leurs nids dans les zones protégées du réseau Natura 2000, les déplacements quotidiens s'étendent au-delà de ses limites, ce qui augmente les risques de mortalité principalement avec les infrastructures artificielles. En fait, un total de 20 aigles sont morts depuis le début du projet (≈40% de tous les oiseaux marqués). Cette forte mortalité non naturelle des adultes, principalement

causée par l'empoisonnement et l'électrocution, pourrait expliquer le déclin observé dans notre zone d'étude au cours des deux dernières décennies.

Mapping and Prioritizing the Insulation of Pylons Endangering Eagles in Israel by a GIS Model Based on Hi-Res GPS loggers

Ohad HATZOFE (ohad@npa.org.il), Nature and Parks Authority, Israel & Asaf MAYROSE, University of Haifa, Israel.

The Bonelli's Eagle (Aquila fasciata) experienced a dramatic decline in Israel during the last 40 years: from 30 to 15 and became considered as regionally critically endangered. Long term monitoring reveals that the survival of juvenile eagles and their recruitment rates are dramatically affected by mortality on medium voltage distribution pylons. Since 2011, 29 (74%) out of 39 cases of eagle mortality and injury were caused by electrocution. Electrocution is responsible for the mortality of juveniles that fledge in Israel, as well as of overwintering individuals, probably originating from northern populations.

A population viability analysis demonstrates that the species is expected to become extinct in Israel over the next few decades, yet it shows that annual addition of two to three juveniles to the population would have a dramatic contribution to its stabilization and even gradual growth.

Since electrocution is the main threat, it is imperative to minimise its annual toll, by insulating dangerous pylons. On the other hand, the insulating process is slow and expensive (since 1996, the Israeli Electric Corporation insulated some 4,000 pylons out of 330,000 in the entire distribution network), hence there is a strong demand for directing the retrofitting towards the most dangerous pylons in the most frequently used areas by the eagles.

In order to prepare an informed plan for insulating the most dangerous pylons, the data collected by high resolution GPS-loggers fitted on 32 BE (both from the wild and captivebred) was used in a GIS model that mapped the most sensitive areas where eagles disperse and where they tend to perch. The model also incorporates data of physical properties of the landscape and land use, influencing eagle's tendency to perch on pylons. The ultimate mitigation priority is set also according to pylon's specific design and its relative insulating cost.

Adaptive management for electrocution mitigation in Bonelli's eagle: successes and future challenges

Antonio Hernández-Matías* & Joan Real

Equip de Biologia de la Conservació, Departament de Biologia Evolutiva, Ecologia i Ciències Ambientals , and Institut de la Recerca de la Biodiversitat (IRBio), Universitat de Barcelona, Av. Diagonal 643, 08028 Barcelona , Catalonia, Spain.

*ahernandezmatias@ub.edu

Mortality caused by power lines is a major threat to raptor species conservation. However, our understanding of how to optimize the implementation of mitigation actions is still partial, which limits our capacity to implement effective mitigation campaigns over extensive power line networks. Adaptive management (AM) is based on an iterative learning-based decision making, so it offers a suitable framework to improve the effectiveness of future mitigation actions. Therefore, it is critical that mitigation actions are well planned and that main conservation targets are monitored before and after the implementation of measures. Here, we illustrate several examples of successes in the mitigation of electrocution on the Bonelli's eagle in Catalonia. To assess the effectiveness of actions we monitored whether: 1) retrofitted pylons were effective at reducing the number of casualties; and 2) demographic parameters of target populations were restored after mitigation actions were done. Our results illustrate that retrofitting was highly effective both to reduce raptor electrocution and to restore survival to levels that guarantee the long-term viability of our target population. Even so, we detected several weaknesses to suitably monitor and to implement mitigation actions at a broader spatial scale, which include: 1) the standardization of protocols of casualties monitoring; 2) the estimation of baseline levels of electrocution of target species; and 3) the recording and sharing of databases on electrocution casualties and the type of corrections implemented between conservation actors (e.g. managers, companies and researchers). Based on our experiences, we develop an AM framework for electrocution mitigation that accounts for the mentioned weaknesses and that we are currently implementing in our study area. Overall, we highlight that AM provides a powerful framework to improve our understanding to effectively mitigate this threat on raptor species.

Long-term monitoring and ringing are key for effective conservation of the Bonelli's eagle

Joan Real*, Francesc Parés, Jaume A. Badia-Boher, Antonio Hernández-Matías

Equip de Biologia de la Conservació, Departament de Biologia Evolutiva, Ecologia i Ciències Ambientals , and Institut de la Recerca de la Biodiversitat (IRBio), Universitat de Barcelona, Av. Diagonal 643, 08028 Barcelona , Catalonia, Spain.

*jreal@ub.edu

Long-term monitoring of biodiversity is an essential tool on wildlife management and conservation that enables a temporal and regular assessment of key biological indicators and populations. For species of conservation concern, the monitoring of demographic parameters provides crucial information to evaluate the status of populations and its viability prospects as well as to develop effective management and conservation actions in an adaptive framework. Here, we show a long-term monitoring of one Bonelli's Eagle population conducted in Catalonia (NE Spain) from 1980 to 2021. Main demographic parameters measured were the occupation status of territories, chick productivity and adult survival. Moreover, a ringing scheme of nestlings was carried out in 1986-1992 and 2008-2019, and it involved 584 individuals. During this long period of population monitoring two contrasting population trends occurred: from 1984 to 2000, a regular decrease of the population was observed from 85 territorial pairs to a minimum of 65; and from 2001 to nowadays, the number of territories stabilized and, then, regularly increased until achieving 81 pairs. Parallel to the population increase adult survival slightly improved while a reduction of productivity was observed. Return rates of fledglings showed much higher values during the increasing period than during the decreasing period. Accordingly, preadult survival during the increasing period showed markedly high values, although comparable information of the study species for this parameter only exists for the French population. Sensitivity and population viability analyses highlighted that both adult and preadult survival are the major drivers of the observed trends. Therefore, the mitigation of factors that directly affect the mortality of the species like the retrofitting of power lines causing electrocution and the improvement of abundance of prey in dispersal areas may have seriously contributed to the recovery of this population. In conclusion, the long-term monitoring of the population, including the tagging of individuals combined with the application of suitable quantitative methods provides critical information about reproduction, recruitment, dispersal and survival. These data do not only allow understanding unknown aspects of the species ecology, but also constitute an effective tool to conserve endangered species populations.

Posters

Causes of mortality for Bonelli's eagle in Cyprus, 1996-2021: Spatial and temporal patterns

N.Kassinis[1], P.Kostantinou[2], H.Hadjistillis[1] and A.Lysandrou[1]

[1]Game and Fauna Service, Ministry of Interior, Cyprus

[2]Veterinary Services, Ministry of Agriculture, Natural Resources and Environment

The Bonelli's eagle (BE) is the only eagle species that breeds on the island of Cyprus. It is an iconic species of Mediterranean ecosystems, protected through European and National legislation. The Game and Fauna Service (GFS) works in close cooperation with the Veterinary Services (VS) of the Republic of Cyprus. All injured, sick and dead wildlife that is found by GFS is taken to the VE where they are examined, treated and/or a necropsy is performed. Injured and or sick wildlife (mostly avian species) are taken to GFS Rehabilitation centre where they are treated and when fully recover, they are released back in the wild.

From 1996 to 2021, 64 BE were found dead or injured and were brought for treatment/post-mortem examination. More than a third of these cases were in Pafos district, whereas Larnaca and Nicosia were 25% and 22% respectively, with Limassol involving only 14% of them. Three cases involved GPS-tagged birds dying in Turkish-occupied north part of the island.

Cause of injury/death was mostly shooting (47%) and poisoning (23%), collision with powerlines/structures and electrocution (14%), trapping on limesticks (2%) and 15% unknown and/or unspecified. Shooting occurred mostly during the November-December (hare/partridge hunting season) (57%) and less during January/February migratory bird hunting season (30%). On the other hand, poisoning occurred mostly from January – May (67%) with the rest occurring from September-December.

Almost half of the cases involved juveniles (43%), a third involved adults (34%) and the rest (23%) were 2nd-year immatures. Most common cause of injury/death for juveniles was shooting (39%) and poisoning (26%), whereas poisoning was the primary cause of death (42%) for 2nd-year imm. eagles with collisions and electrocutions coming 2nd (34%). Adults suffered mostly from shooting with 72% of cases, whereas the rest was due to poisoning.

Sixteen cases of dead BE involved tagged birds; In the period 2002-2009, 4 out 14 eagles tagged with VHF transmitters were found dead due to shooting (75%) and poisoning. In the period 2019 -2021, 12 out of 35 Bonelli's eagles tagged with GPS/GSM loggers, as part of the international project LIFE BONELLIS EASTMED, were found dead or injured. Shooting was involved in 42% of cases, whereas for the first time electrocution (2 cases) and collision in wind farms (1 case) were documented. Poisoning involved 2 cases, one was secondary poisoning - rat poison / bromadiolone). Remarkably, the last case is the first reported case of secondary poisoning involving a large raptor in Cyprus.

Tri-axial accelerometry reveal important differences in energy expenditure in eagles during parental activities

*ARTURO M. PERONA, Movement Ecology Lab (Cavanilles Institute of Biodiversity and Evolutionary Biology. University of Valencia) Valencia, Spain.

OLGA EGEA-CASAS, Movement Ecology Lab (Cavanilles Institute of Biodiversity and Evolutionary Biology. University of Valencia) Valencia, Spain.

JON MORANT ETXEBARRIA, Department of Ornithology, Aranzadi Sciences Society, Donostia-San Sebastián, Spain.

VICENTE URIOS, University of Alicante, Alicante, Spain.

PASCUAL LÓPEZ-LÓPEZ, Movement Ecology Lab (Cavanilles Institute of Biodiversity and Evolutionary Biology. University of Valencia) Valencia, Spain.

Cutting-edge technologies are currently helping us to develop new workflows in studying ecological data, particularly our way to understand animal behaviour and movement trajectories at individual level. Parental care of the Bonelli's eagle was quantified in Spain in the late 70s for the first time, however recent studies are still focused on direct observational or video recording data. However, what happens out of our sight still remains unknown. Our main goal was to describe and quantify sex-biased task specialization and energy expenditure patterns in parental care investment of the Bonelli's eagle by means of a neutral data-driven method. Moreover, we hypothesize that individuals in less suitable territories must expend extra energy during the most demanding periods of the breeding season. Taking advantage of high-resolution GPS/GSM dataloggers and tri-axial accelerometers we monitored 25 Bonelli's eagles (*Aquila fasciata*) during the breeding season to understand parental activities from a broader perspective. To this end, we used recursive data, measured as number of visits and residence time, to reveal nest attendance patterns of biparental care with role specialization between sexes. Furthermore, we used Tri-axial accelerometry data interpreted as the Overall Dynamic Body Acceleration, to account for energy expenditure, which showed strong differences in energy expenditure throughout the breeding season and between sexes. Thereby, males increased substantially their energetic requirements, as a consequence of the increased workload, while females spent most of the time on the nest. Furthermore, during the most important phases of the breeding season, a low percentage of good hunting spots in eagles' territories lead them to increase their ranging behaviour in order to find food, with important consequences in energy consumption and mortality risk. Our results highlight the crucial role of males in the breeding tasks of the Bonelli's eagle. Finally, we exemplify how biologging technologies are an adequate and objective method to study parental care in this species and other large raptors, as well as to get deeper insight into breeding ecology of birds in general.

Bonelli's Eagle *Aquila fasciata* (Vieillot, 1822), electrocution mortality in sensitive Guelmim-Oued Noun province (south-west Morocco): a global review and new evidence

Mohamed Aourir[2]*, Ali Irizi[1], and Abdeljebbar Qninba[1]

[1] Département de Zoologie et Ecologie Animale, Institut Scientifique, Université Mohammed V, Rabat, Maroc
[2] Equipe « Biodiversité et fonctionnement des écosystèmes », Département de Biologie, Faculté des Sciences, Université Ibn Zohr, Agadir, Maroc

* Email: maourir@gmail.com

Electrocution has various degrees of negative impact on different groups of birds. Data of Bonelli's Eagle *Aquila fasciata* (Vieillot, 1822) were gathered from a literature review and from results of a survey carried out in the southeastern Moroccan province of Guelmim-Oued Noun, since 2016. At least, 322 electricity poles of different designs along 53.5 km of distribution power lines were surveyed. A total of 65 raptors killed do to electrocution were encountered during our field survey period, of which 29.23% (n=19) were Bonelli's Eagles.
Considering published data mentioning power line electrocution of Bonelli's Eagle and results of our survey, a total of 41 (44.4%) Bonelli's Eagles causalities were caused by electrocution in the same area. These electricity distribution lines are a serious conservation problem which may potentially impact the resident and dispersal wintering large raptors, especially Bonelli's Eagles.

Key words: *Aquila fasciata*, electrocution, power lines, southeastern Moroccan

Symposium Aigle de Bonelli _ 23&24 septembre 2021 à Montpellier

30 years of ringing Bonelli's eagles in France

Cécile Ponchon[1], Alain Ravayrol[2]

[1] CEN PACA, cecile.ponchon@cen-paca.org

[2] La Salsepareille Salsepareille@orange.fr

The ringing programme began in 1990 in France, in the aim of studying the population dynamic, then the home ranges of the adults and the dispersal of the juveniles through the development of GPS tracking. This information then allows the implementation of relevant conservation actions

Le programme de baguage a débuté en 1990 en France, dans l'objectif d'étudier la dynamique de la population puis les domaines vitaux des adultes et la dispersion des jeunes à travers le développement du suivi GPS. Ces informations permettent ensuite la mise en œuvre des actions de conservation pertinentes.

Using species distribution modelling to reveal potential nesting sites of Bonelli's Eagle on the island of Crete

A. Anagnostopoulou[1], E. Georgopoulou[1], G. Kontogeorgos[1], Y. Vardanis[1], A. Kardamaki[1], K. Damianakis[1], S. Xirouchakis[1]

[1]*Natural History Museum of Crete, University of Crete, University Campus (Knossos), Heraklion 71409, Crete, Greece*

Understanding the nesting preferences of birds of prey in decline is a crucial point in assisting wildlife managers to apply appropriate management and policy actions for their conservation. In Greece, the population of Bonelli's Eagle is estimated to be 100-140 breeding pairs and is considered to be "Vulnerable" according to the National Red Data Book. The insular population of Bonelli's Eagle on Crete have occupied up to 34 territories during the last 25 years. The aims of the present study were: 1) to update the species current status namely the size of its breeding population, 2) to locate and spatially map all the active and abandoned nesting sites and 3) to investigate the factors that affect nest-site selection. Overall breeding activity was confirmed on 20 territories while a total of 63 nesting sites were located and mapped. By applying a generalized linear model on a set of pre-selected bioclimatic and environmental variables, the factors that determine the species nest site selection were identified. In addition a nesting habitat suitability map was constructed by using maximum entropy model and a Geographic Information System by using the best explanatory variables. Overall it was shown that Bonelli's eagles select low altitude areas (<400m a.s.l.), on steep cliffs within small gorges at the periphery of mountain areas with sparse shrubland in the surroundings or in coastal regions with low human density. Human-induced mortality and land use changes are regarded as significant factors for the observed pattern of the observed abandoned territories.

Keywords: nest site prediction, species distribution model, habitat preference, insular population, conservation actions

Symposium Aigle de Bonelli _ 23&24 septembre 2021 à Montpellier

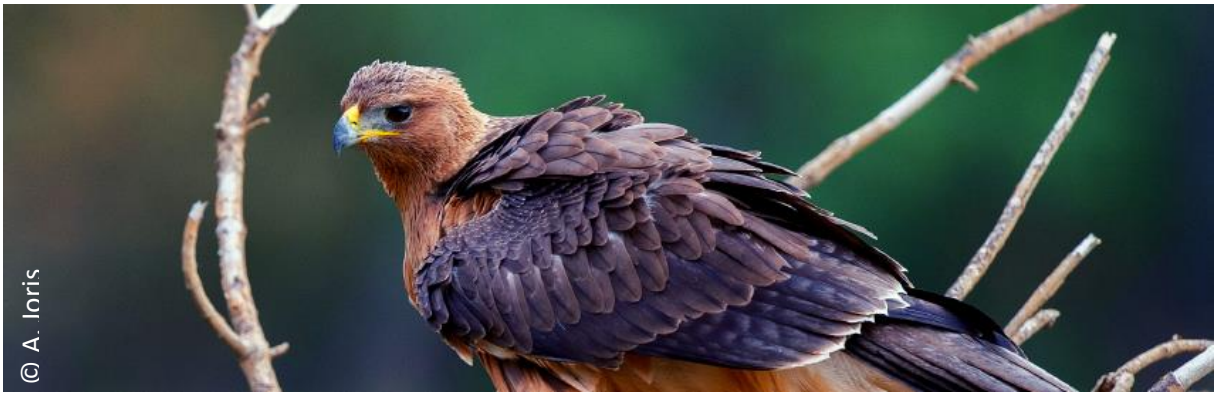
Conservatoire d'espaces naturels Occitanie

PRÉFET DE LA RÉGION OCCITANIE
Liberté
Égalité
Fraternité

Conservatoire d'espaces naturels Provence-Alpes-Côte d'Azur

LPO

AGIR pour la BIODIVERSITÉ AUVERGNE-RHÔNE-ALPES



© A. Ioris

PRÉFET DE LA RÉGION OCCITANIE
Liberté
Égalité
Fraternité

La Région Occitanie Pyrénées - Méditerranée

ENEDIS L'ELECTRICITE EN RESEAU

PLAN NATIONAL D'ACTIONS EN FAVEUR DE L'AIGLE DE BONELLI