

**RAPTOR RESEARCH FOUNDATION
12 - 16 NOVEMBER 2018
SKUKUZA CAMP
KRUGER NATIONAL PARK
SOUTH AFRICA**



CONFERENCE CO-HOSTS



SCHEDULE AT-A-GLANCE

Tuesday, November 13, 2018

8:00-9:40	Welcome Announcement and Plenary	Ndlopfu
9:40-17:00	Old World Vultures Symposium	Ndlopfu
10:00-12:00	Movement	Ndau & Nari
10:00-17:00	Raptors and Overhead Electrical Systems	Ingwe & Mhelembe
13:20-15:00	Habitat	Ndau & Nari
15:20-17:00	Foraging and Diet	Ndau & Nari
17:00-18:00	Group Discussion on Global Vulture Conservation and Research	Ndlopfu
18:00-20:00	Poster Session I	Ndlopfu

Wednesday, November 14, 2018

8:00-9:40	Announcements and Plenary	Ndlopfu
10:00-15:00	Social Sciences and Vultures Symposium	Ndlopfu
10:00-12:00	Speed Talks	Ndau & Nari
10:00-15:00	Falconry and Raptor Research Symposium	Ingwe & Mhelembe
13:20-15:00	Breeding	Ndau & Nari
15:20-17:00	Plumage and Genetics	Ndlopfu
15:20-17:00	Behavior	Ndau & Nari
15:20-17:00	Migration and Wintering	Ingwe & Mhelembe
17:00-18:00	Group Discussion on Connecting Methods and Innovations Across Old and New World Vulture Conservation	Ndau & Nari
17:00-18:00	ECRR Social	Ndlopfu
18:00-20:00	Poster Session II	Ndlopfu

Thursday, November 15, 2018

8:00-9:40	Announcements and Plenary	Ndlopfu
10:00-12:00	Urban Raptors Symposium	Ndlopfu
10:00-12:00	Andersen Award Student Presentations	Ndau & Nari
10:00-15:00	Raptor Health Symposium	Ingwe & Mhelembe
13:20-16:00	Anthropological Impacts	Ndlopfu
13:20-16:00	Conservation	Ndau & Nari
15:20-16:00	Raptor Surveys and Methods	Ingwe & Mhelembe
16:00-16:40	RRF Members Business Meeting	Ndlopfu
19:00-21:00	Banquet	Ndlopfu

TABLE OF CONTENTS

<u>Sponsors</u>	2
<u>General Information</u>	4
<u>Conference Tours</u>	5
<u>Acknowledgments</u>	6
<u>Vendors</u>	7
<u>Skukuza Rest Camp</u>	8
<u>SANparks Regulations</u>	10
<u>Welcome Letters</u>	12
<u>Workshops</u>	16
<u>Plenary Speakers</u>	18
<u>Conference Schedule</u>	20
<u>Symposium Abstracts</u>	26
<u>General Session Abstracts</u>	66
<u>Speed Talks Abstracts</u>	91
<u>Poster Sessions Abstracts</u>	97
<u>Code of Conduct</u>	123
<u>Speakers Index</u>	125

CONFERENCE CO-HOSTS

Raptor Research Foundation

www.raptorresearchfoundation.org

Founded in 1996, Raptor Research Foundation (RRF) is a non-profit scientific society formed to accumulate and disseminate scientific information about raptors in order to inform the scientific and lay public about the role of raptors in nature and to promote their conservation.



Endangered Wildlife Trust

www.ewt.org.za

The EWT is a leading, high-profile player in the arena of conservation. We identify the key factors threatening biodiversity and develop innovative methodologies and best practice guidelines to reduce these and promote harmonious co-existence and sustainable living for both people and wildlife. We achieve our goals through specialist programmes, and our skilled field staff are deployed regionally and throughout southern Africa.



**ENDANGERED
WILDLIFE TRUST**
Protecting forever, together.

BirdLife South Africa

www.birdlife.org.za

BirdLife South Africa is a registered non-profit, public benefit environmental organization and the only dedicated bird-conservation organisation in South Africa. The mission is to conserve birds, their habitats and biodiversity through scientifically-based programmes, through supporting the sustainable and equitable use of natural resources and through encouraging people to enjoy and value nature.



SPONSORS

Special thanks to all of our event sponsors for helping make this conference possible.



Griffon level



Photo by André Botha



Condor level



Photo by Chris Parish



Eagle level



Photo by André Botha



Hawk level



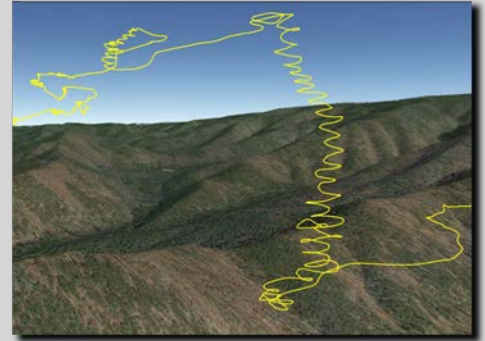
Kestrel level



Photo by André Botha



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 Email: sales@celltracktech.com
 +1-866-582-8707

GENERAL INFORMATION

Please wear your name tag at all times, as it serves as your admission ticket to all events covered by your registration fee. Wi-Fi is available in the conference centre. However, there is no Wi-Fi in the sleeping rooms and chalets.



Registration

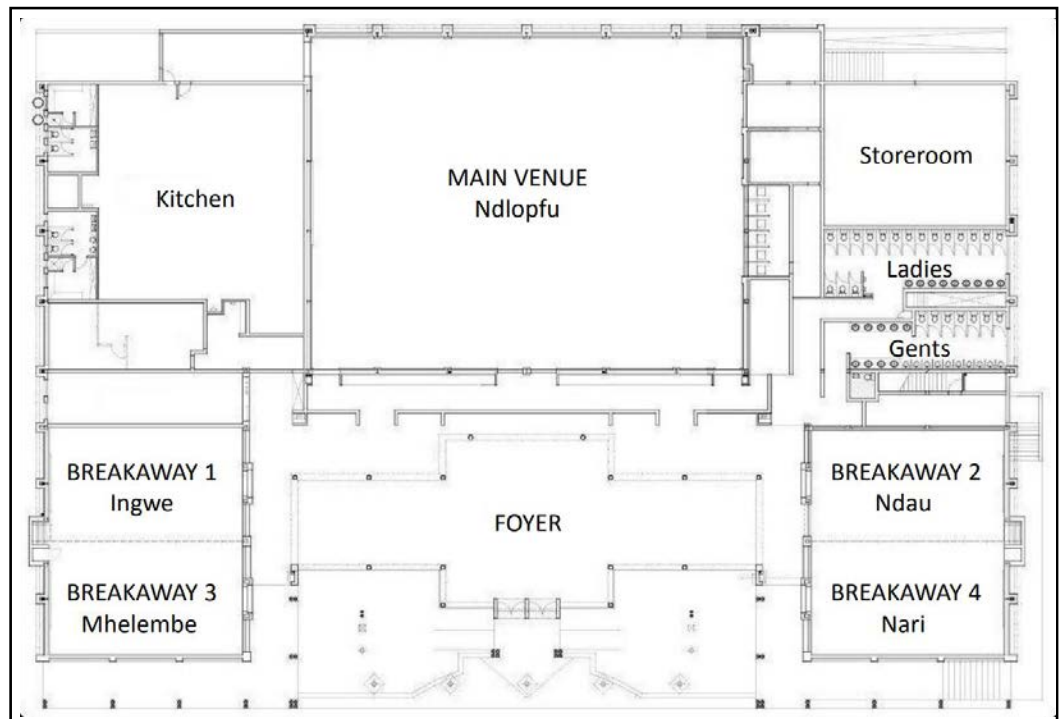
Registration for the 2018 Raptor Research Foundation Conference includes your welcome packet, the Conference Program Book and admission to all Symposia, Plenaries and General Sessions. It also covers the following:

- Monday evening Welcome Function
- Tea/Coffee breaks twice each day on Tuesday, Wednesday, and Thursday
- Poster Sessions on Tuesday and Wednesday evenings
- Conference-related charges by the Skukuza Rest Camp (daily park fees; meeting rooms, breakout rooms, audio-visual equipment, sound, etc.)

The registration and information desk will be situated in the foyer of the Nombolo Mdluli Conference Centre for the duration of the conference. The desk will be open on:

- Sunday, 13:00-19:00
- Monday-Thursday, 08:00-18:00
- Friday, 08:00-13:00

Conference Rooms



Thursday Night Banquet Schedule

- I) Welcome at 19:00 – André Botha
- II) Award Presentations – Gary Santolo
Tom Cade Award; Fran and Frederick Hamerstrom Award; William C. Andersen Award; Stephen R. Tully Memorial Grant; James R. Koplín Travel Award; Leslie Brown Memorial Grant; and Dean Amadon Grant
- III) President's Award - Presented by Libby Mojica
- IV) Conference Host Recognition – Presented by Libby Mojica and Dan Varland
- V) 2019 RRF Conference – Rick Harness
- VI) African Marimba Band with Traditional Dancers

Code of Conduct

Please read the RRF Code of Conduct in the Conference Program Book (pages 123-124). Our goal is to make everyone feel comfortable during the conference and provide a friendly environment for exchanging conversation and ideas. Refer to the Code of Conduct for information on reporting incidents.

CONFERENCE TOURS

Birding Tours



Bustards Birding Tours

Bustards Birding Tours
www.bustardsbirding.co.za
Pre- and post-conference
Northern Cape
Kasane - Caprivi - Okavango Panhandle

Birding & Wildlife Safaris



Lawsons
www.lawsons-africa.co.za
Pre-conference
Escarpment and Kruger National Park
Western Cape
KZN, Swaziland & Kruger National Park

Raptor Safari



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www.raptoursllc.com
Kruger National Park



ACKNOWLEDGMENTS

Many people came together to create the 2018 Raptor Research Foundation (RRF) Conference in Kruger National Park, South Africa. The first conversation in planning this conference, a Skype call in March 2016, included André Botha and RRF Conference Committee members Dan Varland and Gerald Niemi. Needless to say, there have been many conversations and many, many people involved since that auspicious beginning. Many thanks to all who contributed their time and talents, including the session moderators and committee members identified below. Using a Lappet-faced Vulture photo by André Botha, Jack DeLap designed the iconic conference logo. Your Conference Program Book was designed by Joseph Dane, in collaboration with Dan Varland and Samantha Page-Nicholson. With more than 275 delegates attending from 36 countries, the 2018 conference would not be possible without the services of africaMASSIVE, a for-profit, South Africa-based conference planning service. In consultation with RRF and the Endangered Wildlife Trust, africaMASSIVE created and managed the conference website, handled online registration, communication with conference delegates, and arranged for the printing of the program book. We are very grateful to have had the professional help of africaMASSIVE's Angus Morton, Magda Baillie, and Tersia Tengmann.



africaMASSIVE
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Special thanks to...

Local Committee

André Botha, Chair
Samantha Page-Nicholson
Constant Hoogstad
Gareth Tate
Hanneline Smit-Robinson
Linda van den Heever
Melissa Whitecross

RRF Conference Committee

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Early Career Raptor Research Committee

Joe Eisaguirre, Chair
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Awards Committee

Sofi Hindmarch, Chair
Clint Boal, Andersen Award Chair
James Harper, Koplín Travel Award Chair
Gary Santolo

Contributing Photographers

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Bill Clark
Samantha Page-Nicholson
Chris Parish

Moderators

Arjun Amar
Rob Bierregaard
Keith Bildstein
Travis Boom
André Botha
William Bowerman
James Dwyer
John Elliott
Matthew Gage
Constant Hoogstad
Márton Horváth
Tom Katzner
Robert Kenward
Oliver Krone
Lourens Leeuwner
Audrey Martin
Trish Miller
Jemima Parry-Jones
Gary Santolo
Lucia Liu Severinghaus
Jen Shaffer
Janusz Sielicki
Hanneline Smit Robinson

VENDORS

Thanks to all of our vendors for their participation. Vendor booths are located in the presentation room area throughout the conference. Make sure to stop by and visit the vendor booths.



Cellular Tracking Technologies

www.celltracktech.com

The founders of Cellular Tracking Technologies have over 40 years of telemetry research experience between them. In 2007, when not satisfied with the current products on the market, they created CTT in order to bring the newest innovations and highest levels of service to the wildlife research market.



Kaddas Enterprises

www.kaddas.com

Kaddas Enterprises is the manufacturer of Birdguard™, used by Power Utilities to mitigate Animal Caused Power Outages. Kaddas is ISO 9001:2015 Certified and is WBENC Certified 100% Woman Owned. We specialize in Plastic Thermoforming, Pressure Forming, and Hand Fabrication of Polymer solutions. Kaddas uses state of the art Master Cam 3D modeling, 5 Axis CNC Machining and performs all design, development and tooling in our Utah facility. 100% Made in the USA, by choice.



South African National Parks Honorary Rangers

www.sanparksvolunteers.org

SANParks Honorary Rangers is a group of passionate and unpaid volunteers who give freely of their time and skills to support conservation in South Africa's national parks. They provide the people and business community of South Africa with an opportunity to support and become involved in conservation efforts in our national parks.



TechnoSmArt

www.technosmart.eu

TechnoSmArt specializes in the development and production of miniature GPS loggers, accelerometers, and TDRs which have been deployed for tracking birds, mammals and wildlife in general.



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SKUKUZA REST CAMP

Skukuza Rest Camp in the Kruger National Park is a popular camp situated in the heart of Big Five territory and is easily accessed by road and air travel. Skukuza features a variety of accommodation options including camp sites, 21 furnished safari tents, semi luxury bungalows, cottages and 4 guesthouses.

The myriad of birds and wild game in the area are easily spotted by going on bush walks and game drives. Wildlife documentaries are shown in an outdoor amphitheater.

In November, the temperature on average dips to 18°C / 64°F at night and peaks at 30°C / 86°F during the day. Skukuza is the largest rest camp in the Kruger National Park and serves as its headquarters and main hub for nature conservation. Here you will find museums, cottages, huts, restaurants, shops, facilities for day visitors, camping and caravan sites, a petrol station, vehicle emergency service, car hire, an airport, a post office, a bank, a doctor and a laundromat. When you drive through the imposing gates into Skukuza, you find yourself in an administration centre abuzz with scientists, rangers, and conservationists. A wealth of knowledge can be gained in the information center, while adults and children can attend lectures in the nearby environmental education centre. A museum has been constructed at the railway siding, which was used on the Selati line in the 1920's. You can have a meal in a restaurant housed in two old railway carriages from the same period.

The camp is located in the southern region of the Kruger National Park. Also worth a visit is the Campbell 1929 Hut Museum. This national monument was one of the first tourist huts to be established in Skukuza and houses interesting relics from the period. Skukuza has over 200 huts, making it the Kruger National Park's largest camp.

Skukuza Rest Camp Facilities:

- Information at reception
- Library
- Medical practitioner
- Public telephone
- Post box
- Bank
- Car hire
- Car wash
- Two restaurants
- Auditorium and conference facilities
- Internet cafe
- Delicatessen
- Communal ablutions
- Two swimming pools in camp (for overnight residents only)
- Cafeteria
- Shop
- Laundromat
- Filling station
- Communal kitchens
- Cutlery and plates hampers (from Reception)
- Basic first aid assistance
- TVs (limited DSTV) available in family bungalows only
- DSTV (limited channels) available in luxury units only
- Day visitors picnic spot (located 4 km outside the camp) with own swimming pool
- Cellphone reception
- Skukuza Indigenous Nursery (located approximately 5km outside camp)
- Magnificent 9-hole (18-tee), par 72 golf course

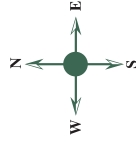




**South African
NATIONAL PARKS**

SKUKUZA CAMP

Enjoy your stay with us



SPECIAL FEATURES:

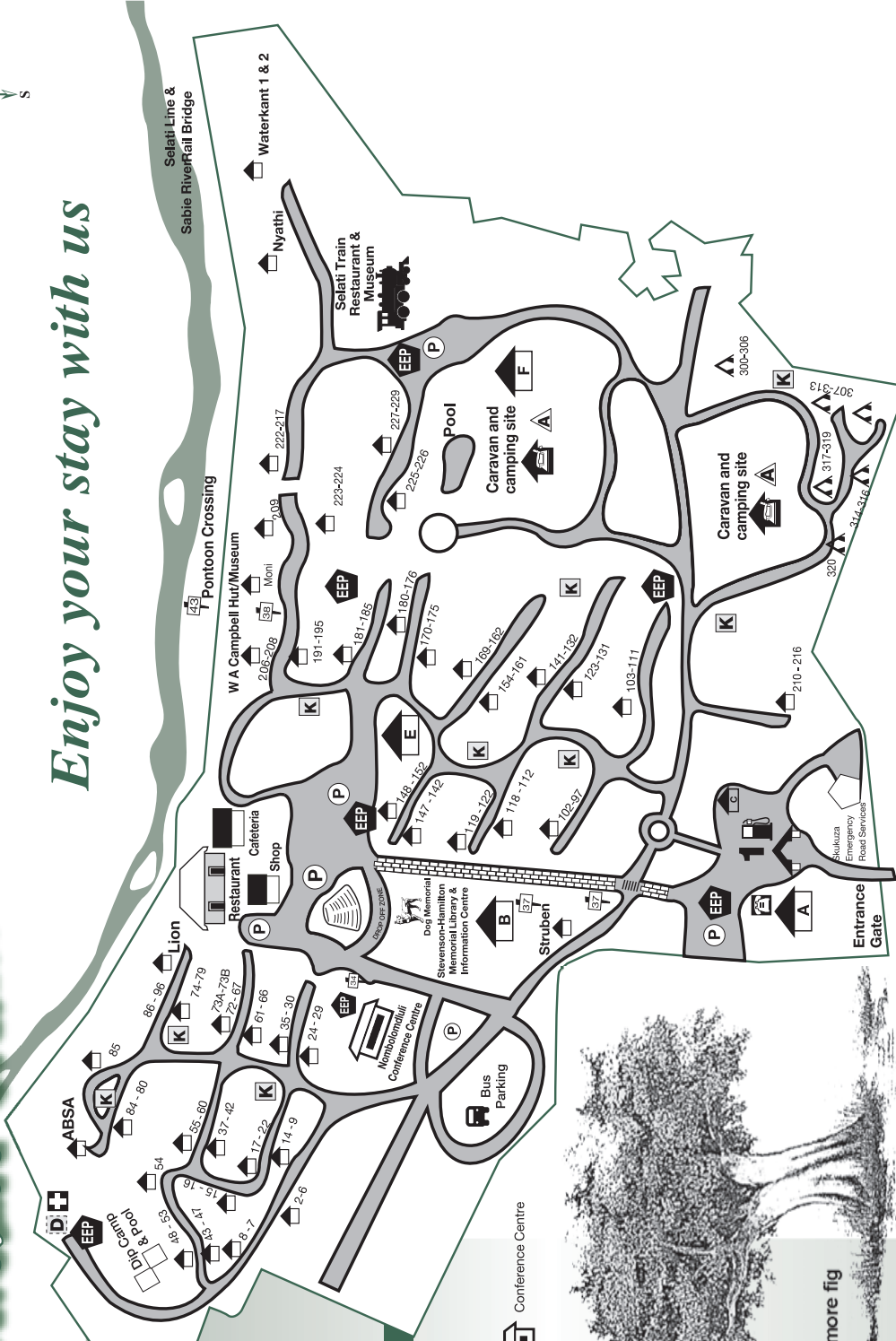
- Skukuza Emergency Road Services
- Airport
- Museums
- Day/Night Drives
- Nursery of Indigenous Plants
- School Journey Services
- Police Station
- First National bank
- Conference Facilities
- Accommodation for Disabled
- Day Visitors Area with Pool

KEY

- Reception/Toilets/Post Office/FNB Bank
- Library/Auditorium/Information centre
- Car Wash
- Restaurant/Toilets/Shop/Cafeteria
- Housekeeping
- School journey services
- Administration block
- Entrance gate
- Laundromat and Irons
- Car parking
- Bus parking
- Petrol & diesel
- Public telephone
- First Aid / Doctor
- Accommodation
- Ablution block
- Communal kitchens
- Film shows
- Caravan and camp sites
- Historical sites
- Skukuza Emergency Road Services
- Doctor
- Permanent tents
- Emergency Evacuation Points



Sycamore fig



PLEASE DEPOSIT KEYS IN KEY BOX AT GATE BEFORE DEPARTURE

DUTY MANAGER CELL NO. 082 802 1204

SANParks REGULATIONS

The function of SANParks is to protect, conserve and control the national parks and other protected areas assigned to it and that you are subject to the conditions set in terms of Section 86 of the National Environmental Management Act (107 of 1998) and the National Environmental Act: Protected Areas Act (Act 57 of 2003) for the duration of your stay in the National Park. Your attention is specifically drawn to section 64(1) (a), (b) & (c) which refers to penalties in terms of the Act.



To ensure a safe and joyful trip through our parks, kindly adhere to the rules and regulations under the Protected Areas Act. Transgression of the rules and regulations as summarized below may result in prosecution and/or penalties.

1. **INDEMNITY:** Guests entering national parks will be required to sign document indemnifying SANParks against any claim, action, judgment, costs and/or expenses which may be made against SANParks.
2. **IDENTIFICATION:** Please ensure that acceptable means of identification are taken along when visiting parks. This does not only apply to the drivers of vehicles but could be requested of all adults that enter or visit parks.
3. **CONSERVATION FEES:** Daily conservation fees are payable for every day/ night stayed in national parks. The acquisition of a Wild Card is available as an alternative to paying daily conservation fees.
4. **COMMUNITY FUND:** SANParks have implementing a 1% Community Levy on all reservations (overnight and activity products) arriving on or after 1 June 2012. This is used to fund projects that support surrounding communities in bettering their livelihoods. For more information please view our website on www.sanparks.org
5. **STAY IN YOUR VEHICLE** – In most of the national parks there is a possible threat from dangerous animals. In such parks guests may only alight from vehicles in designated areas. No part of your body may protrude from a window or sunroof and doors should remain closed at all times;
6. **THE MAXIMUM SPEED LIMIT** – Please take careful note of the speed limits applicable in the various areas of the parks. Note that not all roads are accessible to caravans and/ or vehicles exceeding a certain mass, type or size.
7. **ALCOHOL:** The consumption of alcohol in public areas is prohibited. Day visitors are prohibited from entering Kruger National park with any alcohol in their vehicles.
8. **DRIVE SAFELY** – General rules of the road apply within the parks. It is an offence to drive on South African roads without a recognized driver's license or under the influence of alcohol. Driving or operating any vehicle in a reckless or negligent manner or in a deliberate disregard for the safety of a person, animal or property is a serious offence and can result in a summons being issued. Driving a vehicle in a manner that constitutes a nuisance, disturbance, inconvenience or danger to any other person may also be subject to a summons being issued.
9. **ADHERE TO GATE TIMES** – Gate times must be strictly adhered to. Please take note of the different times that apply at gates and also camps and lodges within the parks. Guests must plan their travelling thoroughly and make adequate provision for contingencies. After hours driving is not allowed and could result in a summons being issued.
10. **OVERNIGHT VISITORS** – Guests are only allowed to stay at a booked and recognized overnight facilities and must report to the relevant reception before occupying accommodation or camping;
11. **CAMPsites** – Camping base rates include one motorized vehicle per campsite. Additional motorized vehicles per campsite are charged at a rate equivalent to the campsite base rate per night.
12. **AGE RESTRICTIONS:** For safety reasons some activities conducted in parks have age restrictions. Please take cognizance of these in order to prevent disappointments.
13. **DEPARTURE TIMES** – All accommodation and camping sites may be occupied from 14:00 on day of arrival and must be vacated by 10:00 on

the day of departure;

14. DRIVING AREAS – Vehicles must remain on the designated roads at all times and off-road driving or driving on closed or no-entry roads is a serious offence. In many areas, overnight facilities are to be accessed only by booked overnight guests;

15. FEEDING OF WILDLIFE IS PROHIBITED – The feeding or intentional disturbance of wildlife is a serious offence. By feeding any wildlife you are potentially SIGNING THEIR DEATH WARRANT, AS THEY MAY BECOME DEPENDENT AND OFTEN BECOME AGGRESSIVE AND DANGEROUS, AND THUS HAVE TO BE EXTERMINATED;

16. FLORA & FAUNA – No plant, animal, wildlife or any natural or cultural items may be removed from the park without permission. To cut, damage, destroy or be in possession of any plant or part thereof, including dry wood or firewood is a serious offence. Importing of any specimen of an alien or listed invasive species into a national park is prohibited;

17. VEHICLE RESTRICTION – There are restrictions to the type of vehicle that may enter national parks. Please take careful note of vehicle restrictions applicable to the different roads and areas of the parks.;

18. PETS– No pets (dogs, cats, birds or any other) may be brought into a Park. Transgressors will be dealt with firmly, issued with a summons and the pets will be destroyed. Guide dogs for visually impaired guests are one exception, but only in consultation with park management and if the owner has the necessary inoculations and permits as ordained by the state veterinary department;

19. LITTER-FREE ZONE – Littering is prohibited. Deposit or leaving of any litter except in receptacles for that purpose will result in a fine;

20. DECLARE FIREARMS AT GATE – All firearms/dangerous weapons of any sort, any explosive, trap or poison must be declared upon entry, and firearms will be sealed;

21. NO KILLING OF ANIMALS – Poaching and killing or injuring of animals is strictly prohibited;

22. FIRE HAZARD– Starting or causing of any fire, whether it be intentional or unintentional other than in a fireplace or container purposely made available is strictly prohibited and will result in a summons being issued

23. SMOKING– Please take note of the smoking regulations applicable in the parks

24. BEHAVIOUR – Behaving in an offensive, improper, indecent or disorderly manner including the playing of any radio, compact disc player, music system, musical system or instrument, or in any way cause of any noise in any manner likely to disturb any species or specimen or other person is strictly prohibited and will be fined if not adhered to. The hindering, intimidating or obstructing of an authorized official in the execution of his/her duties or the performance of his/her functions will not be tolerated and is subject to a penalty. Violation, refusal or failure to obey or comply with any prohibition, request or instruction imposed by these regulations or by the management authority or authorized official will result in prosecution;

25. BICYCLES: Please enlighten yourself with the rules and regulations applicable to the use of roller skates, skateboards, bicycles and motorbikes for the park/s that you will be visiting as there are restrictions in some of the parks;

26. DRONES: The use of drones inside (and over) national parks is strictly prohibited.

27. BEWARE MALARIA – Kruger and Mapungubwe National Parks fall within a malaria zone. A 24hour malaria hotline is available on 0822341800 and where relevant, please consult your medical practitioner.

28. PARK SPECIFIC INFORMATION – Kindly familiarize yourself with the general conditions prevalent in the park you are going to visit by visiting the website at www.sanparks.org and link onto Parks A-Z as there may be vital information contained therein to assist with your visit.

WELCOME LETTERS



**ENDANGERED
WILDLIFE TRUST**
Protecting forever, together.

Welcome to the African bush and its raptors.

It gives me great pleasure to welcome you to the 2018 Raptor Research Foundation annual conference at Skukuza in the Kruger National Park, one of Africa's prime wildlife areas and a haven for a wide range of raptors and owls.

The last 18 months have been quite an interesting and busy time since our invitation to the Raptor Research Foundation to hold the conference in Africa was accepted. The real scope of what we had committed ourselves to became evident at the Salt Lake City conference in November 2017 and I was initially concerned that the cost and time required to travel to South Africa may result in only a small number of people being able to make the journey to attend this year's conference.

At the time of writing this note of welcome, I am glad to say that these fears were unfounded and that this year's conference will host more than 270 delegates from 36 countries. The lure of the African bush, its wildlife and diversity of raptors certainly must have contributed to this excellent turn-out and we look forward to hosting you this week and sharing some of the magic of this part of Africa with you.

A conference such as this would not be possible without the input and support of a range of organisations and individuals. I would like to thank Tersia Tegmann, Magda Baillie and Angus Morton from Africa Massive who have carried the bulk of the burden in making the conference possible by means of their excellent website and behind-the-scenes engagement with various stakeholders, including you, the delegate. Thank you to South African National Parks for their assistance with a range of matters, especially the field trip that many of you will participate in on the last day of the Conference. I also owe a debt of gratitude to our colleagues at BirdLife South Africa as well as all the staff from the Endangered Wildlife Trust who have been involved in numerous meetings and assisted with other arrangements to ensure that the conference will be a success.

We trust that you will have a productive and enjoyable week and establish lasting friendships and working partnerships to the benefit of raptors globally.

Yours sincerely,



André Botha

Chair: Local Organising Committee – Raptor Research Foundation Annual Conference 2018

Manager: Vultures for Africa Programme, Endangered Wildlife Trust

Co-chair: IUCN SSC Vulture Specialist Group





STRATEGIC PARTNERSHIP

Eskom EWT Strategic Partnership

Eskom and the Endangered Wildlife Trust (EWT) formalised their long-standing relationship by entering into a partnership in 1996. The Eskom/EWT Strategic Partnership was established to address the potential problems in a systematic manner from a national perspective, and to establish an integrated management system to minimise these negative interactions.

The Objectives of the partnership are:

- Assist with the mainstreaming of biodiversity into the Eskom business, through specialist advice on latest trends, biodiversity management practices, biodiversity networking and through input into the Eskom Biodiversity Strategy.
- Maintain, implement and regularly review the existing national central incident register for all wildlife interactions.
- Investigate reported wildlife interactions with Eskom infrastructure (including those on Eskom-owned properties).
- Support with research on, and the design of, mitigation measures to reduce negative wildlife interactions with all electrical infrastructure, including renewable energy and impacts related to business risks.
- Raise awareness through effective communication amongst Eskom employees and the general public on the issue of wildlife interactions.
- Provide support through investigation and monitoring of Eskom renewable energy projects.



The Eskom/EWT Strategic Partnership continues to be of benefit to, and valued by, both partners. Since its inception, the partnership has built this specialised field worldwide, and remains a highly respected and esteemed collaboration internationally, achieving its objectives through a range of activities.

Contact details:
+2711 372 3600
web@ewt.org.za



STRATEGIC PARTNERSHIP

WELCOME LETTERS



BirdLife South Africa is a partner of BirdLife International, a global partnership of nature conservation organisations. Member of IUCN (International Union for Conservation of Nature).

Reg No: 001 – 298 NPO
PBO Exemption No: 930004518

Sanibonani, Namukelekile e-Africa! Welcome to South Africa, we trust that you will enjoy the warm hospitality of our people, witness the natural beauty of our country and marvel at the rich biodiversity to be found. The Kruger National Park is indeed an appropriate venue for the Raptor Research Foundation conference as it is the stronghold for many of our threatened raptor species. More than 490 bird species are known from Kruger National Park alone and it is duly recognised as a global Important Birds and Biodiversity Area (IBA), which includes about 57% of all the species to be found in the entire southern African sub-region. Many wide-ranging species that are rare outside large national parks may be commonly found in the Kruger National Park. Such species include Hooded, White-backed, White-headed and Lappet-faced vultures, Marabou Stork, Martial Eagle, Kori Bustard and Southern Ground-Hornbill. Many other threatened birds of prey include Bateleur, Secretarybird, Pel's Fishing Owl, Tawny Eagle, Lanner Falcon, Bat Hawk and African Grass Owl.

We wish you an enjoyable conference in the iconic African bush. May this be an excellent networking opportunity: a time to meet new colleagues and to make new friends, an opportunity not only to share in our passion for raptors, but importantly, to make a difference in raptor research and conservation. May long lasting memories accompany you back to your home destinations.

About BirdLife South Africa's raptor research and conservation:

BirdLife South Africa is the country's only dedicated bird conservation organisation, and the South African partner of BirdLife International, with 120 partners and more than ten million members globally. In line with the global Partnership and BirdLife South Africa's vision, BirdLife South Africa strives to conserve birds, their habitats and biodiversity through scientifically based programmes, through supporting the sustainable and equitable use of natural resources and through encouraging people to enjoy and value nature. With 35 staff members across the country and a growing number of volunteers, BirdLife South Africa and its team strive to save species (including through the prevention of extinctions and through keeping common birds common), conserve sites and habitats, encourage ecological sustainability and empower people for positive change (which includes to catalyse support for nature, promote local conservation action and strengthen the global BirdLife partnership).

BirdLife South Africa's Terrestrial Bird Conservation Programme (TBCP) is dedicated to the conservation of diverse and sustainable bird populations, recognising their crucial role in maintaining balanced terrestrial ecosystems. Our mission is to identify, prevent and/or reverse negative trends in terrestrial birds through scientifically-based and community-based conservation initiatives.

There are 132 bird species listed as regionally threatened, of which 47 are 'Near Threatened' with the remainder at higher threat levels as recorded in The 2015 Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland, recently produced by BirdLife South Africa and its partners. Worryingly, the number of species in the Critically Endangered category has increased from five to 13 since 2000, including six raptors (Bearded, Hooded, White-backed and White-headed vultures, as well as Taita Falcon and Southern Banded Snake Eagle). Further, 22 of the 80 raptors in the region are considered threatened. Given the widespread degradation and destruction of our natural resources, the risk of extinction is increasing for many of our bird species. As apex predators, raptors are indicators of the health of the environment and play a critical role in the food chain.

African vultures are currently labelled the most threatened group of birds on earth and are plummeting towards extinction. Of the seven vulture species resident to South Africa, three species (White-backed, Hooded and White-headed) are listed as globally Critically Endangered, while Cape and Lappet-faced vultures are listed as Endangered. In October 2017, BirdLife International published a Multi-species Action Plan (MsAP) for the conservation of Africa and Eurasia's vultures, accepted by the Convention on Migratory Species (CMS) COP in 2017. BirdLife South Africa's focus, in collaboration with the Endangered Wildlife Trust, on a regional scale is to introduce Vulture Safe Zones to southern Africa where land owners pledge to manage their properties (especially large tracts of land) in a way that is conducive to vulture conservation. BirdLife South Africa is currently investigating the impact of lead toxicosis on South Africa's vultures. Our results show blood lead concentrations found in Cape and White-backed vultures far exceed levels consistent with background exposure. A review on the ecological role of vultures in disease ecology is currently being prepared.

Our focus on raptors include projects on the regionally Critically Endangered Taita Falcon and Southern Banded Snake Eagle. The South African Taita Falcon Survey Team, BirdLife Species Guardian, has established a long term dataset for the monitoring of the breeding success of the South African Taita Falcon population over the past 12 years. Our conservation efforts on Southern Banded Snake Eagle aims to increase our understanding of the distribution and ecology of this species in northern KwaZulu-Natal, South Africa, and to limit the threat of electrocutions by electrical infrastructure. Our recent work on the movement ecology of Secretarybirds is summarised in a peer-reviewed publication. The wide-ranging nature of the juveniles exposes them to a diverse range of threats and a better understanding of their movements will help develop appropriate conservation strategies for this terrestrial raptor. Guidance to mitigate fence line collisions aim to reduce the impact of this threat which annually claims the lives of many Secretarybirds, owl species and other birds. We are also engaged in a collaborative conservation initiative, through the involvement of the BirdLife Black Harrier Species Guardian, FitzPatrick Institute of African Ornithology, to prevent the extinction of this endemic raptor.

Sincerely,



Dr Hanneline Smit-Robinson

Manager: Terrestrial Bird Conservation Programme/Oppenheimer Fellow of Conservation
BirdLife South Africa



White-headed Vulture | Photo by André Botha

WORKSHOPS

Global Review of Raptor Trapping, Banding, Tagging and Tracking

Room: Ndlopfu | Time: November 12, 2018 from 08:00-13:00

Facilitators: Munir Virani, The Peregrine Fund; José Tavares Vulture Conservation Foundation



The trapping, banding, tagging and tracking of raptors as research methods currently form part of many projects across the globe. There are however growing concerns with regard to the possible impact of these practices on the birds, especially with regard to the lack of guidance and standards and the often inadequate legal and ethical frameworks within which these practices are applied. This workshop aims to review current practices and systems in this regard and to make recommendations towards the implementation of appropriate measures to ensure that any negative impact on study species are minimized. We also aim to make recommendations on the implementation of appropriate measures to ensure that practitioners receive appropriate training and assessment.

Emergency First Aid Treatment of Raptors. Saving Raptors, One Bird at a Time

Room: Ndau | Time: November 12, 2018 from 08:00-12:00

Instructor: Ben Hoffman Raptor Rescue



This short course will give students a practical guide on the emergency handling, management and stabilizing of raptors. The course is aimed at the initial management of poisoned, birds, collision and trauma injuries, emaciation, and downed birds, prior to seeking veterinary assistance. Students will have the opportunity to learn how to restrain, crop tube, administer fluids, stabilize fractures and other injuries, and prepare the bird for transport to a qualified facility. Class will be taught at the conference facility, and raptor cadavers will be supplied for practical demonstrations.

African Raptor Field ID, Molt and its Use in Ageing, and Recent Taxonomic Changes in African Raptors

Room: Nari | Time: November 12, 2018 from 08:00-12:00

Instructor: Bill Clark, Harlingen, TX, USA

This class will begin with introduction to identification (ID) of diurnal raptors, followed by two sessions on field ID of African raptors. The last session will focus on raptor remige molt and its use in ageing, with differences between Falconiformes and Accipitriformes molt presented, ending with a summary of recent changes in raptor taxonomy. Class will be taught at the conference venue. Suggested text: African Raptors, new raptor field guide by Clark and Davies.

Using Drones to Study Raptors

Room: Ndau | Time: November 12, 2018 from 14:00-17:00

Instructors: David M. Bird, Emeritus Professor, McGill University; Lourens Leeuwner and Mattheus Pretorius, Endangered Wildlife Trust – Wildlife & Energy Programme

This class is intended to bring participants up to date on the application of drone technology to studying and conserving raptors. While raptors will be



the main species discussed, we will also include how drones are being used for other bird species around the world with the idea of applying such technology to birds of prey. Topics will include counting eggs and nestlings in nests, detecting and tracking raptors, mapping habitat and its use by raptors, and avoiding unwanted raptor strikes. There will also be emphasis on how regulations are affecting the use of such technology in a number of countries. It is not legal to undertake drone flight demonstrations in Kruger National Park, so this workshop will largely consist of PowerPoint discussions with plenty of time for questions and answers as well as input from the audience. Class will be taught at the conference venue.

Techniques for Handling, Marking, and Blood Sampling Raptors after Capture: A Bird in the Hand is Worth Two in the Bush

Room: Ingwe | Time: November 12, 2018 from 14:00-17:00

Instructors: Dan Varland, Coastal Raptors, U.S.A., John Smallwood, Montclair State University, U.S.A. and Petra Sumasgutner, FitzPatrick Institute of African Ornithology, University of Cape Town, South Africa.

This course will provide students with experience in proper techniques for raptor handling and blood sampling, with specific emphasis on how to reduce stress and risk for injuries. Instruction in auxiliary marking will focus on applying two kinds of patagial tags, one for smaller raptors such as the Amur Falcon and another for larger, soaring raptors. Use of leg rings, inks or dyes and feather imping as markers for identification will also be covered. The blood sampling part will introduce different invasive (tarsal and brachial vein, spot sample from a toe) and non-invasive techniques such as the use of blood-sucking bugs and will also focus on appropriate storage media. Class will be taught at the conference venue.



Harnessing Raptors with Transmitters

Room: Mhelembe | Time: November 12, 2018 from 14:00-17:00

Instructors: Libby Mojica, EDM International, Inc.; Trish Miller, Conservation Science Global, Inc; Sonja Kruger, Ezemvelo KwaZulu-Natal Wildlife; and Andre Botha, Endangered Wildlife Trust, Steve Lewis, US Fish and Wildlife Service

This class will cover the process of attaching a transmitter (either VHF or satellite) to raptors, from initial thoughts of the bird's welfare to specifics of making harnesses and attaching them to birds. The majority of the class will be hands-on, involving creation of a backpack-style harness and using that harness to attach a transmitter to carcasses of different sized raptors. As time allows, we may discuss other attachment techniques (e.g., tailmount, patagial) as well as thoughts on data management. Class will be taught at the conference venue.



Raptor Nest Surveys: Searching From the Air and on Foot for Cliff, Tree and Ground

Room: Nari | Time: November 12, 2018 from 14:00-17:00

Instructors: Gerard Malan, Tshwane University of Technology, South Africa, Sonja Krueger, and Rob Simmons

This course will explain how set up raptor nest surveys and how to collect inventory data that you can later employ for informed and effective raptor conservation. It presents field techniques that you should master to develop a 'sixth sense' for locating the birds and their nests. For tree and cliff nesters the course will address the numerous components that allow efficient and successful ground and aerial nest searches (helicopter and fixed wing), including neighbor nest mapping. Ground nest surveys will cover the various components of searching for harrier nest sites on foot.

PLENARY SPEAKERS

Enhancing Collective Creativity to tackle Raptor Conservation Challenges in Africa

*MUNIR VIRANI (virani.munir@peregrinefund.org), The Peregrine Fund, Boise, ID, U.S.A.

Africa is home to 110 species of diurnal raptors and 43 species of owls making up more than a quarter of the world's raptor species. During the past decades, the number and diversity of raptors across the continent have declined dramatically, principally because of an increase in human populations across the continent, which has resulted in habitat loss, agricultural intensification, and the increased use of poisons. Africa's Sub-Saharan economy has been growing at an average rate of 5% in the last 20 yrs whilst its human population is predicted to reach 2000000 by 2050. This will unequivocally compound the threats that raptors will face in the future. In 2008, I delivered a Plenary at the Pan African Ornithological Congress in Cape Town, South Africa highlighting the challenges of raptor conservation in Africa. Key "take-home" messages revolved around research challenges such as closing the gap between little and well-known species, better understanding distribution patterns to inform conservation strategies, and using cutting edge technology to increase scientific knowledge particularly movements. Overcoming these challenges was critical for translating conservation science into practical action. There were also educational and capacity development challenges such as developing a "Centre for Excellence" in raptor research, conservation and education and having more African graduates and women in raptor biology. Fast forward to 2018, and there have been significant strides in research, capacity development and awareness in African raptor biology and conservation efforts. The development of a continental-wide African Raptor Network has fostered closer communication, collaboration and conservation impact over a wider geographical area. The success of the African Raptor Observations app has revolutionized our understanding of raptor distribution and abundance at a continental scale. Raptor studies are now shifting towards finding practical and cost-efficient solutions to multiple landscape level threats - such as human-wildlife conflicts, poisoning, and raptor collisions with energy infrastructure whilst paying greater attention to involving local communities and investing in the next generation of conservation leaders. There is a shift towards developing partnerships and using different skill sets in collating and publishing continental-wide data sets, inspiring a new generation of African researchers and influencing policy at government and community level to achieve maximum conservation benefit. As the challenges to conserve Africa's raptors become more complex, we propose an approach of collective creative activity that emerges from the collaboration and contribution of many individuals so that new forms of innovative and transformative science and conservation action is achieved collectively by individuals connected by an already existing network.



Critical New Insights into the Movement Ecology of Old and New World Vultures

*KEITH L. BILDSTEIN (Keith.bildsteing@gmail.com), Hawk Mountain Sanctuary, PA, U.S.A.

Satellite tracking provides critical new insights into the movement ecology of vultures and other scavenging birds of prey. I use the satellite-tracked movements of Hooded (*Necrosyrtes monachus*), Turkey (*Cathartes aura*), and American Black Vultures (*Coragyps atratus*) throughout their ranges in Africa and the Americas as examples of how this new information can change ideas about how and why raptors move about their ecological neighborhoods. I also discuss these findings in terms of their causes and their consequences. The Critically Endangered and largely non-migratory Hooded Vulture exhibits extreme regional differences in the sizes of its home-ranges and in its population densities, with human-dependent, "commensal" populations in West Africa exhibiting much smaller home



ranges and much higher densities overall than non-commensal populations elsewhere in Africa. Hooded Vulture home ranges also respond markedly to habitat modifications across international borders. Common and largely non-migratory American Black Vultures living close to the northern limits of the species range in eastern North America predictably adjust short-distance winter movements in response to weather, whereas those living in tropical areas adjust seasonal distributions in response to the arrival of migratory Turkey Vultures. Finally, in both North and South America, the common, widespread, and often migratory Turkey Vulture demonstrates considerable variation in both the lengths and geography of its seasonal migratory movements, with some migratory populations demonstrating high “migration connectivity,” and others demonstrating low connectivity. Overall, these findings highlight extreme flexibility in the movement ecology of both non-migratory and migratory Old and New World vultures. The fitness consequences of this flexibility awaits systematic study. Given the plight of vultures globally, investigations such as these provide a valuable framework for developing a more robust understanding of the factors underlying the movement ecology of these and other more imminently threatened scavenging birds of prey.

Use of *Haliaeetus* Eagles as Key Indicators of the Health of the Environment

*WILLIAM BOWERMAN (wbowerman@umd.edu), University of Maryland, College Park, MD, U.S.A.



Sea Eagles (Genus *Haliaeetus*) were, with Peregrine Falcons, the first avian predators to indicate the effects of environmental pollutants post-World War II. Long-term studies of these species include studies that began in the 1950s in Scandinavia on White-tailed Eagles (*Haliaeetus albicilla*), in Africa on the African Fish Eagle (*Haliaeetus vocifer*), and in North America on Bald Eagles (*Haliaeetus leucocephalus*). The impacts of DDT and other organochlorine pesticides were demonstrated in large-scale, long-term population studies of these species. Over the past 30 yrs, with more accurate methods to age nestlings, first egg laid in the nest has advanced in Bald Eagles by 0.8 days per year on average for those nesting along the Great Lakes shorelines. Preliminary analyses have found some adaptive effects on nestling size due to increases in temperatures. Utilizing a 57 yr annual census for the state of Michigan on bald eagles, these and other techniques will be described. The transfer of these methods or how other projects on other *Haliaeetus* eagles are also utilizing these long term studies of both pollution and climate change will be illustrated. Studies have also been conducted on human disturbance, critical habitat assessment, migrations, and associations with hydroelectric operations. Sea Eagles are excellent indicator species for many human caused impacts in the environment. However, as with any indicator species, there are some drawbacks. How they are best used as ecosystem monitors will be discussed.

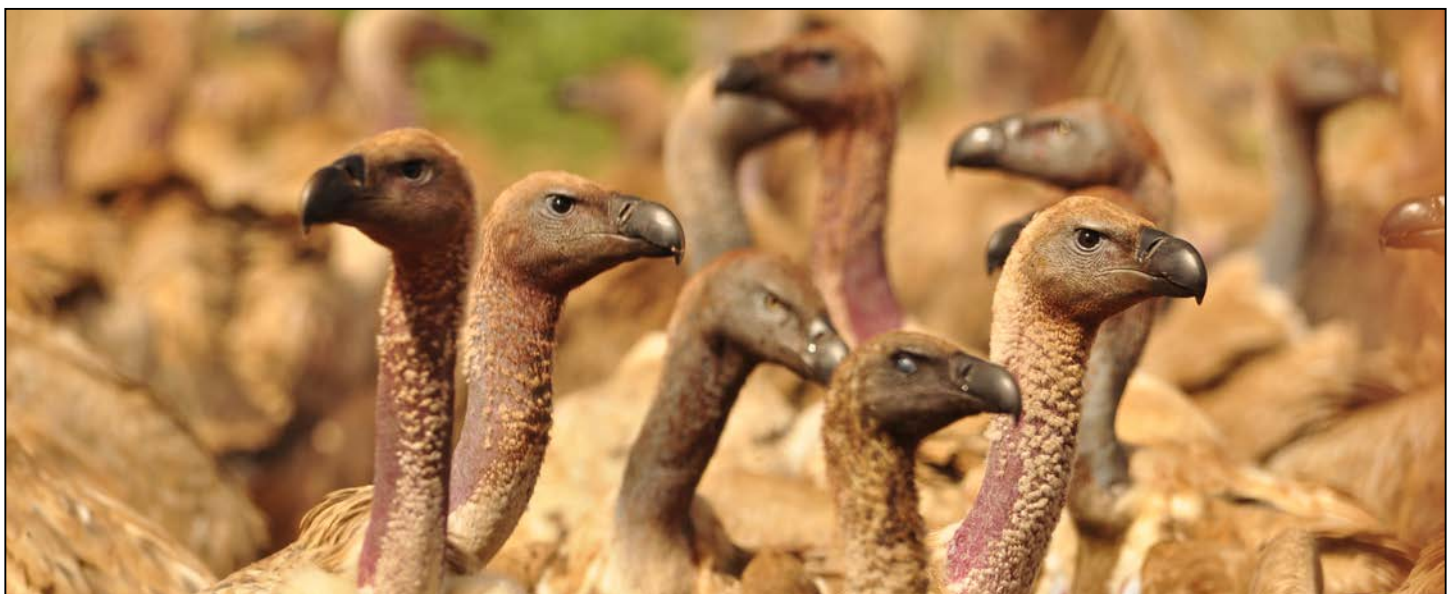


Photo by Samantha Page-Nicholson

TUESDAY SCHEDULE

Tuesday, Nov 13	Ndlopfu	Ndau & Nari	Ingwe & Mhelembe
8:00-9:40	Welcome and address by Xolani Nicholus Funda, General Manager Conservation Management of Kruger National Park		
	Announcements		
	Plenary Talk by Munir Virani, Enhancing Collective Creativity to tackle Raptor Conservation Challenges in Africa		
	Old World Vultures Symposium I (co-chairs Andre Botha and Keith Bildstein)	Movement (moderator)	Raptors and Overhead Electrical Systems I (co-chair James Dwyer)
9:40	Murn, VISA - the metadata project concept to improve connectivity for vulture research and conservation	<i>Break</i>	
10:00	Parry-Jones, Status and Conservation of South Asian Gyps Vultures	Katzner, Aeroecology of the California Condor	Chetty, The Milestones and Activities to Reduce the Impacts of Energy Infrastructure on Wildlife
10:20	Buji, Mapping African vulture strongholds and their threat levels to inform conservation action	Panuccio, Migration of Black Kites from Italy to the Sahel	Page-Nicholson, Raptor Electrocutions, Collisions on Overhead Power Lines and Mitigating this Threat
10:40	Buechley, Identifying critical migratory bottlenecks and high-use areas for an endangered migratory soaring bird across three continents	Phipps, Tracking Egyptian Vultures from Spain-Portugal to the West African Sahel	Kruger, An Analysis of Vulture Mortalities on Powerlines in South Africa from 1996–2018
11:00	Tavares, The reintroduction of bearded vultures in Europe: background, context, results and recommendations from one of the greatest wildlife comebacks of our times	Macias-Duarte, Aplomado Falcons in the Chihuahuan Desert	Hoogstad, A Pro-Active Approach to Mitigation for Raptor Mortalities on Power Lines in South Africa
11:20	Bracebridge, Evidence that Two Distinct, Stable and Significant Populations of African Vultures Persist in Southern Tanzania	Hadjikyriakou, Habitat Effects on Route Selection and Movement Pace of Migrating Eleonora's Falcons	Beutel, Raptor Phase-to-Pole Electrocutation Risk Estimation and Mitigation on Overhead MV Powerlines Using an Electrical Model
11:40	Duriez, Flight and foraging decision making in Griffon Vultures	Meyburg, Amur Falcon Across the Open Sea	Pérez-García, Global Factors Driving Bird Electrocutation on Power Lines
12:00-13:20	<i>Lunch</i>		

TUESDAY SCHEDULE

Tuesday, Nov 13	Ndlopfu	Ndau & Nari	Ingwe & Mhelembe
	Old World Vultures Symposium II (co-chairs Andre Botha and Keith Bildstein)	Habitat (moderator)	Raptors and Overhead Electrical Systems II (co-chair Lournes Leeuwner)
13:20	Kaltenecker, Apparent Numerical Response of Obligate and Facultative Avian Scavengers to Annual Rainfall in Gorongosa National Park, Mozambique		Mojica, Eagle Electrocutions and Mitigation Approaches
13:40	Thompson, Variation in Monthly Home-Range Size of Hooded Vultures in West, East and Southern Africa	Losee, Golden Eagle Nest Site Selection in Arizona	Tincher, Small Unmanned Aircraft Systems Examine Hazards in Osprey Nests
14:00	Scott, Movements of White-headed Vultures and White-backed Vultures from Gorongosa National Park, Mozambique	Huysman, Effects of Wine Country Wildfires on Barn Owl Habitat Selection in Napa Valley	McGowan, Raptor Electrocutation Risk and a Collaborative Protection Solution Model Deployed in Israel
14:20	Murn, A clear and present danger: impacts of poisoning on a vulture population and the effect of poison response activities	Davies, Causes for the Decline in a Regionally Endangered Piscivorous Species	Horvath, Conflict Mapping of Birds and Medium-voltage Electricity Grid in Hungary
14:40	Monadjem, Spatially Explicit Poisoning Risk Affects Survival Rates of an Obligate Scavenger	Paprocki, Predicting Responses of Short-eared Owls to Climate Change	Dwyer, Retrofitting Power Poles to Prevent Electrocutation of Translocated Ridgway's Hawks
15:00	<i>Break</i>		
	Old World Vultures Symposium III (co-chairs Andre Botha and Keith Bildstein)	Foraging and Diet (moderator)	Raptors and Overhead Electrical Systems III (Cheryl Dykstra)
15:20	Odino, Wildlife Poisoning Response Protocol in Northern Kenya	Brink, Vulture Supplementary Feeding Stations in Southern Africa	Kemper, Use of Mobile Nesting Platforms to Reduce Electrocutation Risk
15:40	Choresh, Possible effects of environmental contaminants on breeding success of the Eurasian Griffon vulture (<i>Gyps fulvus</i>) in north Israel	Camiña, Cape Vulture Foraging	Heck, Falconry as a Natural Pigeon Abatement Technique at an Electrical Converter Station
16:00	Kanaujia, Upcoming Ken Betwa link Project (KBLP): a threat to breeding sites of vulture in Panna Tiger reserve, Bundelkhand region, India	Hatfield, Martial Eagle Diet in Kenya's Maasai Mara Region	Sielicki, Falconers Against Electrocutation
16:20	Coverdale, Tracking vultures: Endangered species guiding conservation action in Zululand, South Africa	St. George, Barn Owl Prey Delivery Rate In Napa Vineyards	Garrido López, Pole Design / Mooney, Tasmanian Infrastructure
16:40	Pfeiffer, Cliff characteristics, neighbour requirements and breeding success of the colonial	Wommack, Diet of American Kestrels in Oak Woodland	Harness, Methane Burners / Discussion period
17:00-18:00	Group Discussion on Global Vulture Conservation and Research		
18:00-20:00	Poster Session I		

WEDNESDAY SCHEDULE

Wednesday, Nov 14	Ndlopfu	Ndau & Nari	Ingwe & Mhelembe
8:00-9:40	Announcements Plenary Talk by Keith Bildstein, Critical New Insights into the Movement Ecology of Old and New World Vultures		
9:40	<i>Break</i>		
	Social Sciences and Vultures Symposium I (chair L Jen Shaffer)	Speed Talks (10 minutes each) (Travis Boom)	Falconry and Raptor Research Symposium I (co-chairs Matthew Gage and Robert Kenward)
10:00	Ottinger, One Health and Vulture Populations	Jordon, White-backed Vultures / Solheim, Snowy Owls	Sielicki, Understanding and Re-establishing tree-nesting Peregrine in Central Europe
10:20	Van den Heever, The Link Between Vultures and the Spread of Disease	Martin, Falconinae Reverse Sexual Dimorphism / Leepile, White-backed Vultures	Duriez, The Use of Falconry Birds to Study Flight Behaviours and Energetics
10:40	Gore, Raptor Poaching and Trafficking	Venu, Peregrine Falcons / Kumar, Black Kites	McPherson, Strategies for managing human wildlife-conflict, and the rehabilitation of injured and problem Crowned Eagles in Durban, South Africa
11:00	Santangeli, Techniques to Investigate Wildlife Crime	Jobson, Cape Vulture / Cabre-ra, Raptor Community in La Pampa	Prommer, Conservation Satellite-tracking of Saker Falcons in Russia and Mongolia
11:20	Van den Heever, Quantifying the Levels of Lead Toxicosis in South Africa's Vultures	Slater, Golden Eagles / Meñdez, Neotropical Vultures	McGough, Human-eagle partnerships through the millennia: how falconry cultivates ethno-ornithological knowledge, a commitment to conservation, and respect for the natural world
11:40	Reson, Determining the Drivers and Extent of Poisoning Among Pastoralist Communities in Southern Kenya	Maphalala, Long-crested Eagle / Ogada, Raptors in Kenya	Calvin, Falconry meets technology...advancements in the rehabilitation of raptors in Western Australia
12:00-13:20	<i>Lunch</i>		
	Social Sciences and Vultures Symposium II (William Bowerman)	Breeding (Lucia Liu Severinghaus)	Falconry and Raptor Research Symposium II (co-chairs Matthew Gage, Janusz Sielicki, and Robert Kenward)
13:20	Ruffo, Human Perceptions of and Threats to Vulture	Thorstrom, Nesting Biology of the Bat Hawk in Western Madagascar	Hyde, A Holistic Approach to New Zealand Bird of Prey Conservation

WEDNESDAY SCHEDULE

Wednesday, Nov 14	Ndlopfu	Ndau & Nari	Ingwe & Mhelembe
13:40	Shaffer, Vulture Conservation Social Networks	Batchelor, Crowned Eagles of Mpumalanga, South Africa	Deacon, Distribution and Ecology of the African Crowned Eagle in Zimbabwe
14:00	Harrell, Ethics and Vulture Use	Tate, Karoo Electric Eagles Project, South Africa	Feás, Raptor Conservation Through Captive Breeding and Falconry
14:20	Smit-Robinson, Introducing Vulture Safe Zones to Southern Africa	Koronkiewicz, Supplemental Feeding of Golden Eagles	Potier, Understanding the sensory ecology of raptors: an essential collaboration between falconers and researchers
14:40	Murrow, Saving Africa's Vultures	Bolopo, Helpers Increase Fledgling Body Condition in Cooperatively Breeding African Pygmy Falcon	Kenward, The Past, Present and Future of Falconry's Contributions to Conservation
15:00	<i>Break</i>		
	Plumage and Genetics (moderator)	Behavior (Jemima Parry-Jones)	Migration and Wintering (Rob Bierregaard)
15:20	Amar, Application of Morphic-Google Images Web Tool for Raptor Studies	Whitecross, Dispersal Dynamics of Juvenile Secretarybirds in South Africa	Miller, Bald Eagle Use of Uplands
15:40	Clark, Extreme variation in the tails of Harlan's Hawks	Hart, Post-release Success of Rehabilitated African Fish-Eagles	Garcia-Heras, Annual Movements in an intra-African Migratory Raptor
16:00	Vennum, State Uncertainty: Sex Effects and Correlates of Recruitment	Lanzone, Bald Eagle Nestling Activity	Howes, Wintering European Honey-buzzard Movement and Habitat Use
16:20	Askelson, Genomic Differentiation of Goshawks in British Columbia	Dell'Omo, Movements of Urban Peregrines	Bednarz, Return Rates, Site Fidelity, and Pairing in Wintering American Kestrels
16:40	Johnson, Peregrine Falcon Subspecies Phylogenomics	Gosford, Fire-spreading Raptors in Australian Woodlands	Hadjikyriakou, Spatiotemporal Movement of Wintering Eleonora's Falcons in Madagascar
17:00-18:00		Group Discussion on Connecting Methods and Innovations Across Old and New World Vulture Conservation	
17:00-18:00	ECRR Social		
18:00-20:00	Poster Session II		

THURSDAY SCHEDULE

Thursday, Nov 15	Ndlopfu	Ndau & Nari	Ingwe & Mhelembe
8:00-9:40	Announcements Plenary Talk by William Bowerman, Use of Haliaeetus Eagles as Key Indicators of the Health of the Environment		
9:40	<i>Break</i>		
	Urban Raptors Symposium chair Petra Sumasgutner (Arjun Amar)	Andersen Award Student Presentations (Gary Santolo)	Raptor Health Symposium I (co-chair Oliver Krone)
10:00	Sumasgutner, Understanding the response of peregrine falcons to increasing urbanization and climate change	Lowney, Sleeping with the enemy: the extreme associations of the African Pygmy Falcon to Sociable Weaver colonies	Slabe, Continental-Scale Patterns of Lead Exposure of Facultative Avian Scavengers
10:20	Elliott, The Cooper's hawk (<i>Accipiter cooperii</i>): an indicator of urban environmental contamination	Steiner, Linking Local and Regional Weather Variables to Migration Phenology in North American Raptors	Garbett, Association between Hunting and Elevated Blood Lead Levels in the Critically Endangered African White-backed Vulture <i>Gyps africanus</i>
10:40	Zylstra, Density dependent effects on survival in an urban-nesting population of Cooper's hawks	Azpillaga Diez, Effects of Rearing Conditions on Natal Dispersal Processes	Deak, Using Search Dogs to Reduce Raptor Poisoning in Hungary
11:00	Miller, Nesting Behavior of Suburban Red-shouldered Hawks (<i>Buteo lineatus</i>) in Southwestern Ohio	Dickson, Non-target Exposure of Toxins to Raptors: Anti-coagulant Rodenticides and Ferruginous Hawks	Krone, The European Raptor Biomonitoring Facility: A European network for pollutants in birds of prey
11:20	Sumasgutner, Costs and Benefits of urban living in Eurasian Kestrels	Gallego Garcia, Similar parental care in a generalist raptor: the case of <i>Milvago chimango</i> in a suburban habitat	Bishop, Emerging pesticide issues for raptors with a focus on American Kestrel
11:40	Sharma, Feeding ecology of Indian Eagle Owl <i>Bubo bengalensis</i> (Franklin, 1831) in Lucknow, Northern India	Nebel, Experimental Test of Reaction Times of Pigeons Towards an Attacking Hawk: A Study of the Polymorphic Black Sparrowhawk Under Varying Conditions	Sánchez-Virosta, Blood Concentrations of Toxic Metals and Rare Earth Elements from E-waste in Nestling Eagle Owls / Cococchetta, 3D Printed Lower Limb Prosthesis in Two Raptors: an Harris's Hawk (<i>Parabuteo unicinctus</i>) and in Little Owl (<i>Athene noctua</i>)
12:00-13:20	<i>Lunch</i>		

THURSDAY SCHEDULE

Thursday, Nov 15	Ndlopfu	Ndau & Nari	Ingwe & Mhelembe
	Anthropological Impacts I (Constant Hoogstad)	Conservation I (moderator)	Raptor Health Symposium II (co-chair John Elliott)
13:20	Simmons, Making Green Energy Greener	Owolabi, Raptors of a Pristine Rain-forest	Elliott, Exposure and toxicity of anticoagulant rodenticides in birds of prey from Western Canada
13:40	Ralston-Paton, Mind the Gap and Help Minimise the Threat Wind Energy Poses to Raptors	McClure, State of the World's Raptors	Krone, The avian influenza virus in the white-tailed sea eagle
14:00	Smith, Evaluation of DTBird in Reducing Risk of Golden Eagles Colliding with Operating Wind Turbines	Gross, Using Telemetry in California Condor Research and Management	Forsman, Heat stress in falcons: Continuous body temperature monitoring throughout heat stress challenges and various methods of rapid cooling
14:20	Santander, Raptors in Pine Plantations	Martens, Spatial Ecology and Roost Site of Cape Vultures in the Eastern Cape, South Africa	Discussion
14:40	Mooney, Grey Goshawk Response to Reduced Persecution	Van Zyl, Conservation status of Taita Falcon	
15:00	<i>Break</i>		
	Anthropological Impacts II (moderator)	Conservation II (Hanneline Smit Robinson)	Raptor Surveys and Methods (moderator)
15:20	Murgatroyd, Building a Risk Map Tool for Verreux's Eagle to Minimise Wind Turbine Collision Risk	Ruddock, Population Monitoring and Dynamics of the Peregrine Falcon in Northern Ireland	Schlater, Raptor Mortality along a Highway in the Great Plains, North America
15:40	Oleyar, Kestrel Reproduction in Urban Landscapes	Rene de Roland, Wetland Habitat Conservation from a Species Study: Lesson Learned from Madagascar Fish Eagles	Kennedy, Novel Ecosystems as Raptor Habitat
16:00-16:40	RRF Member Business Meeting		
19:00-21:00	Banquet		



SYMPOSIUM I ABSTRACTS

Conservation and Management of Raptors on Overhead Electric Systems

Co-chairs:

James F. Dwyer, jdwyer@edmlink.com

Lourens Leeuwner, lourensl@ewt.org.za



Electrocution on overhead electric systems is one of the primary causes of direct anthropogenic mortality to raptors, affecting a wide variety of species across size continents, with documented population-level effects contributing to the endangerment of some species. Collisions with suspended wires and negative interactions with renewable energy infrastructure also cause raptor mortalities. Raptor electrocution is also relatively easily prevented through modification of overhead electric systems, if those modifications are carried out correctly and thoroughly. Collisions and interactions with renewables also can be managed. This one day symposium will include reports of recent scientific studies and analyses focused on conservation and management of raptors on overhead electric systems from around the globe, so all attendees may benefit from advances in mitigation strategies employed across disparate electric systems.

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Modeling Raptor Electrocutation Risk on Overhead Medium Voltage Powerlines

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Raptor electrocution on overhead medium voltage power lines due to excessively conductive wood has been found in rare cases. These cases occur when a sufficiently large bird makes simultaneous contact with an energized object, such as a phase conductor, and the top of a sufficiently conductive wood pole, either directly or via a conductive frame. Extensive research has been performed in South Africa on the topic, including measurement of wood resistance in different climates and at different times of the year, and measurement of raptor body and feather resistance. This has resulted in an electrical model being compiled that explains the phenomenon from an electrical engineering perspective. Several papers have been published detailing various results. This presentation will explore the remaining results not previously published and will demonstrate how this mode of electrocution occurs under what conditions, e.g. new or wetted poles, and with the bird's body (not dry feathers). The results will be used to propose a mitigation strategy, based on criteria such as raptor density, annual rainfall and distance from the sea. This presentation will discuss the model results to provide a practical mitigation guide, supported by engineering measurements that has not been proposed before.

Eskom/Endangered Wildlife Trust Partnership 1996-2018, 22 Years of Partnering to Reduce Impacts on Business and Biodiversity

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Eskom Holdings SOC, Ltd. (Eskom) is responsible for providing electricity to meet the ever-increasing needs of its users. As a result, Eskom's electrical infrastructure is continuously expanding to support annual load growth. That infrastructure

can be involved in negative interactions with wildlife including the electrocution of birds (and mammals), birds colliding with power lines, and birds or other animals causing short circuits and outages in the electricity supply. These interruptions have dire consequences for large industries and residential areas. The challenge for Eskom is to find the balance between the electricity demands of the nation, the interests of industry, the residential electrification program, and the effective use and conservation of natural, social, and economic resources. In view of the complexity, Eskom and the Endangered Wildlife Trust (EWT) formalized their long-standing relationship by entering into a partnership in 1996 to address the problem in a systematic manner on a national basis, and to establish an integrated management system to minimize these negative interactions. Twenty-two (1996-2018) yrs later, the partnership is still going strong. The Eskom/EWT strategic partnership evolved over the yrs to include other facets of the business, including the power generation element where Eskom identified the need for the Endangered Wildlife Trust to assist in the management of biodiversity in and around power stations across South Africa. EWT's activities include assistance with the design of biodiversity action plans for all power stations, and guidance on game management, alien plant management, and the rehabilitation of ash dams. Additionally, EWT assists Eskom with the management of wildlife interactions across all Eskom infrastructure and through advising on all biodiversity related issues. This presentation will provide additional detail on the Eskom/EWT partnership.

Discussion Period with Speakers Regarding Journal of Raptor Research Special Issue from the Electric System Symposium

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The Journal of Raptor Research (JRR) is considering a special issue of JRR dedicated to the topic of raptors and overhead electrical systems, based on the contributions to the Conservation and Management of Raptors on Overhead Electric Systems symposium. At the conclusion of the symposium, we will hold a brief meeting with presenters interested in contributing manuscripts to the special issue. Manuscripts will be needed within about 6 mos after the conference, will need to meet all JRR standards, and will be subjected to the usual peer-review process. The current acceptance rate at JRR is about 65%, so manuscript acceptance is not guaranteed. Each manuscript must stand on it's own merit. As of now, there are no special funds

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for this issue, so authors will be subject to the usual publication costs structure. Specifically, if authors have institutional support for page charges, they are expected to pay full fees of \$115 per page (plus \$450 per color figure). If they have no support, they are asked to contribute half the publication costs (for developed-world countries where economic situations are similar to US), or whatever they can contribute (for developing countries). Full waivers can be granted where all authors are students or are from developing nations.

Retrofitting Power Poles to Prevent Electrocutation of Translocated Ridgway's Hawks

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The success of a translocation program for critically endangered Ridgway's Hawks (*Buteo ridgwayi*) in the Dominican Republic was initially limited because hawks were electrocuted on power poles around the translocation site. Specifically, from 2009-2014, 11 of 48 (23%) of translocated hawks were electrocuted, as were individuals of 13 other species. One hundred and fifty poles are now retrofitted and electrocutions have been drastically reduced. However, some electrocutions continue to occur. To understand why, we examined 150 retrofitted poles around the reintroduction site. We found 96 (64%) were retrofitted correctly. The remaining 54 poles (36%) included mitigation plan errors, installation errors, and improvisation errors, either singly or in combination. These errors need to be corrected to maximize the success of the translocation program. Given that the success of the reintroduction program for California Condors (*Gymnogyps californianus*) also was initially undermined by electrocution mortality, as are conservation programs for other raptor species of concern, our findings demonstrate the need to fully understand and mitigate electrocution risks when designing translocation or reintroduction programs for species that perch on power poles. Given that the pole constructions we observed in the Dominican Republic also occur elsewhere in the Caribbean, we suggest that other endemic, resident, and migratory species may also be sustaining preventable electrocution mortality within the region.

Methane Burners and American Kestrels (*Falco sparverius*): A Case Study at a Landfill in Southeastern Massachusetts, USA

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Many American Kestrel populations are declining across North America. Potential causes include reductions in food availability, secondary poisoning from anticoagulant rodenticides, West Nile Virus (*Genus Flavivirus*), depredation, habitat degradation, and climate change. Known direct impacts to American Kestrels include predation, shooting, electrocution, and collision. From 2012 to 2017 we captured 288 American Kestrels at the Carver/Marion/Wareham Landfill located in southeastern Massachusetts, and noted charring of flight feathers on five birds. One bird could not sustain flight; the other four could fly. The 22-hectare landfill is a grassland that includes a small 'candle stick flare' methane burner used to dispose of waste methane. Flares can burn intermittently or continually, depending on the amount of gas produced. Some intermittent flares are automated to turn on when gas reaches a certain level in the system. Others are ignited by a switch which produces a spark at short intervals as the gas passively seeps out of the structure. Raptors use flare stacks for hunting perches making them vulnerable to burns when a flare ignites, or when flying directly over or through flares. If a bird survives a flare contact, burned feathers may render the bird unable to fly. Although raptor rehabilitators have reported methane burns in 14 states, there are no national statistics on birds injured or killed from methane burners, thus it is difficult to assess the scope of the problem.

Falconry as a Natural Rock Pigeon Abatement Technique at an Electrical Converter Station in Alberta, Canada

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AltaLink is the primary electrical service provider in Alberta, Canada, operating and maintaining over 13,000 km of transmission lines and 300 substations. The majority of electricity transmitted is alternating current with the exception of one new direct current line, which came online in 2014. This transmission line moves power generated in the north of the province to the south; direct current transmission is a more efficient way of moving high voltage current across long distances and requires a high voltage direct current converter station at each end to change the electricity to alternating current. At its southern converter station, Rock Pigeons (*Columba livia*) have been occupying the facility since it came online, with the flock size

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steadily growing to an estimated 75 to 100 individuals by fall of 2017. This has resulted in operational issues, primarily because of bird excrement accumulating on equipment and on the ground surfaces in the transformer bays. The excrement is toxic and requires special time-consuming and costly clean-up procedures. Additionally, an outage is required to remove it and clean out the bays. AltaLink's efforts to control the pigeons included live trapping, a sound deterrent system, and washing, all of which were ineffective. In 2018, a trial abatement program using falconry was initiated with four three-d site visits made between January and April. Falcons, primarily hybrids of Gyrfalcon (*Falco rusticolus*) and Peregrine Falcon (*Falco peregrinus*), were flown outside of the main converter station building in combination with other deterrent methods. After the four visits the pigeon flock had been successfully reduced to eight individuals. This presentation will provide an overview of the methods and results, as well as lessons learned and how falconry is now being implemented into AltaLink's long term maintenance strategy.

A Pro-active Approach to Mitigation for Raptor Mortalities on Power Lines in South Africa

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Avian mortalities caused by collisions and electrocutions with overhead power lines have emerged as a significant conservation issue, threatening many species globally. With the continuous demand for energy projected to increase, this anthropogenic mortality will likely grow worse, placing added pressure on already stressed populations. To address this, it is vital that power lines are mitigated to prevent such mortalities. However, with more than a million kilometers of power lines (11-765 kV) in South Africa, it is almost impossible to determine where to start proactively mitigating power lines. The Research Testing and Development group at Eskom Holdings SOC, Ltd. (Eskom) has partnered with the Endangered Wildlife Trust (EWT) Wildlife and Energy Program to conduct a modeling exercise to determine which areas in South Africa have higher avian-power line mortality risk. Using different methodologies, proactive mitigation plans have been developed for Eskom's distribution and transmission networks. Areas which were identified as high risk have been incorporated into Eskom's maintenance plans to ensure that all high-risk lines are mitigated within the next decade. Mitigation techniques include marking lines with bird-

flight diverters to reduce collisions, and changing pole designs and retrofitting existing structures with insulation to reduce electrocutions. Mitigation is generally done reactively, so this proactive approach is novel, yielding successes and lessons learnt that may be applied globally.

Conflict Mapping of Birds and Medium-voltage Electricity Grid in Hungary: A Critical Review of a Voluntary Agreement

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Electrocution on Hungary's medium-voltage electricity grid is estimated to cause the mortality of 30 thousand to 170 thousand birds annually. In a study of 3400 electrocutions in Hungary, we found that about 30% involved raptors, including the endangered Saker Falcon (*Falco cherrug*), globally vulnerable Eastern Imperial Eagle (*Aquila heliaca*) and near-threatened Red-footed Falcon (*Falco tinnunculus*). Collisions with overhead electric lines also pose a significant threat to the globally vulnerable Great Bustards (*Otis tarda*). To mitigate avian risks, the Hungarian Ministry of Environment and Water, BirdLife Hungary (MME), and all three electric utilities signed the voluntary 'Accessible Sky' agreement in 2008. Under the agreement, MME began four tasks: (1) Build and manage a national database compiling all known bird mortalities attributable to power lines. (2) Identify bird-friendly retrofitting for all types of new and existing electricity distribution infrastructure. (3) Calculate costs of mitigation, estimated to reach 250 million euros. (4) Prioritize future mitigation measures in a "conflict map" based on a distribution analysis of 15 affected bird taxa in relation to the nationwide power-line grid in a 2.5 x 2.5 km scale. Our presentation will focus on this conflict map. The conflict map categorized each power-line section into five categories. The top three categories were modeled to be responsible for the majority of bird mortality and therefore were communicated as top priorities to the Ministry of Environment and Water and to electric utilities. Although the Ministry co-financed regional projects and electric utilities retrofitted portions of their networks, the total lengths of the retrofitted sections covered less than 25% of the priority lines to date. We continue to support the voluntary agreement, but due to slow progress we also urge electric utilities to fulfill their legal obligations to mitigate avian

electrocution risk in key bird habitats.

The Use of Mobile Nesting Platforms to Reduce Electrocution Risk to Nesting Ferruginous Hawks

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Electrocution on distribution power lines is a well-known source of mortality for raptors. Risk increases for large raptors that can easily bridge components and make lethal contact. Risk also increases in open landscapes, where raptors may rely on power poles for nesting. Thus, large, native prairie obligate species such as Ferruginous Hawks (*Buteo regalis*), a threatened species in Canada, are at high risk of electrocution. Following two yrs of Ferruginous Hawks nesting on a bypass switch pole on a military base at Suffield, Alberta, with electrocution causing the loss of the brooding female and subsequent nest failure in 2014, as well as the loss of a fledgling in 2015, a pair attempted nesting in 2016. In response, a mobile nesting platform was erected 15 m away, from which the pair successfully fledged young. In early 2017, nest deterrents and insulation were added to the power pole. To accommodate future nesting, but prevent young branching back on to the power poles, a permanent artificial nest platform, along with two dummy branching poles, was erected in 2017 approximately 465 m away from the bypass switch; the mobile platform was moved one third of the distance to the permanent platform, and again, Ferruginous Hawks nested on the mobile platform. In 2018, the mobile platform was moved another one third of the distance, however, no nesting occurred. This management approach was also attempted in 2017 at a similar site; however, the other hawk pair moved straight to the permanent platform, so the mobile platform was removed. This pair did not return in 2018. Despite mixed results at these sites, use of mobile platforms to move nesting raptors away from hazardous poles may serve as a valuable tool to use in conjunction with more standard insulation approaches, especially in landscapes where few nesting alternatives exist.

An Analysis of Vulture Mortalities on Power Lines in South Africa from 1996-2018

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Vulture mortalities recorded by the Eskom Holdings SOC, Ltd. (Eskom)/Endangered Wildlife Trust (EWT) Strategic Partnership since its inception during 1996-2018 will be presented here. We will report on data analyzed to determine species most affected, the type of power line structures responsible for the mortalities, and the key factors that contributed to the mortalities. The number of sites mitigated, as well as the average response time of mitigation measures will be examined. Eskom's policy and standards for re-active mitigation, as well as the recently adopted proactive bird mitigation strategy will be explained. Challenges such as limited funding and the lack of technical solutions to reduce vulture mortalities on power lines in South Africa will also be discussed.

Raptor Electrocutions and Collisions on Overhead Power Lines, and Mitigating this Threat: A Summary of Two Decades

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In October 1996, the Eskom Holdings SOC, Ltd. (Eskom)/ Endangered Wildlife Trust (EWT) Strategic Partnership was formed. This partnership was created to facilitate documenting negative wildlife-energy infrastructure interactions on the Eskom electric system, to mitigate the dangers power lines pose to wildlife, and to reduce the financial burden of these events to Eskom. The Eskom/EWT partnership has revealed that raptors are among the most heavily impacted avian groups, with mortalities caused by electrocutions on unsafe structures and by collisions with poorly visible lines. All incidents are recorded in a Central Incident Register (CIR) that now includes over 3,100 wildlife interaction incidents and over 7,400 wildlife mortalities in the last 22 yrs. Raptor species account for 36% of mortalities in the CIR (n = 2,695). Of the raptor species, vultures are the most commonly reported; making up 70% of reported raptor mortalities, followed by eagles (13%) and owls (9%). Other groups reported include buzzards, falcons, kestrels, goshawks, and kites (7%). Seventy-five percent of these mortalities have resulted from electrocutions on power lines. Multiple mitigation strategies and devices have been developed within the Eskom/ EWT partnership including bird-friendly pole designs, bird-guard equipment covers, and bird-flight diverters. Mitigation is generally done reactively after a mortality occurs. However, in the last two years, the partnership has implemented a proactive

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mitigation strategy. This strategy has identified areas of high risk for bird electrocution and collision and will be used to identify lines for proactive mitigate across South Africa. In the last financial year (April 2017-March 2018), at least 488 power line spans were mitigated with bird flight diverters, including 10 spans mitigated with nocturnal OWL devices, and 656 poles were made bird-friendly through electrocution mitigation, including 27 supporting dangerous transformers.

No pole design without effective mitigation techniques is safe for raptors in Morocco

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Avian electrocutions on power lines are well documented worldwide, though regional research has not been widely disseminated from North Africa. In this study, we report raptors electrocuted on recently erected electric distribution lines in arid landscapes of the SW Moroccan sub desert Guelmin region. The area lacked natural perches but supported large rodent prey populations and large populations of breeding and dispersing Bonelli's Eagles (*Aquila fasciata*), Spanish Imperial Eagles (*Aquila adalberti*), and other raptors. In January 2016 we visited distribution poles in the to identify at risk species and problematic pole configurations. We inspected 403 poles supporting 60 km of lines, and recorded electrocutions on 41 poles: Bonelli's Eagle (n = 40), Long-legged Buzzard (*Buteo rufinus*; n = 12), Golden Eagle (*Aquila chrysaetos*; n = 5), Spanish Imperial Eagle (n = 4), Lanner Falcon (*Falco biarmicus*; n = 4) and Pharaoh Eagle-Owl (*Bubo ascalaphus*; n = 1). All poles were built with grounded metal crossarms, resulting in minimal phase-to-ground clearance. Electrocutions were associated with all crossarm designs, including those with suspended and strain insulators, with jumper wires below or above crossarms, and with equipment poles. There were no statistically significant differences among electrocution rates across pole designs. Our presentation will compare these results to similar configurations in Spain where differences in pole design are associated with differences in electrocution rates. Our observations are particularly concerning because i) a growing network of power lines in Morocco is being built with the configurations we studied, and ii) all the electrocuted Spanish Imperial Eagles, a globally threatened

species, we found bred in the Iberian Peninsula. Failure to protect raptors in their migratory and wintering habitats can undermine conservation efforts in breeding ranges, and failure to protect breeding raptors in Morocco may lead to substantial population impacts.

Raptor Electrocution Risk in Overhead Lines, and a Collaborative Protection Solution Model in Israel

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This presentation will summarize the successful long-term implementation of raptor protection devices on overhead lines in Israel, detailing pre- and post-construction installations. The presentation emphasizes planning, risk assessment, and collaboration between stakeholders as keys to success. Implementation of technical solutions is only part of a comprehensive mitigation program to protect raptors and other avian species against electrocutions, as shown in the results of the raptor protection program in Israel. This program, which started in 1996, was based on collaboration between the IEC (the Utility), the Israeli Nature and Parks Authority (Ministry of Environment) and the Society for the Protection of Nature in Israel (biggest conservation NGO). The base for this collaborative program was the assessment of high risk overhead lines through a 24-month survey. This survey identified lines prone to avian electrocution, with focus on activities in Important Bird Areas declared by BirdLife International. All raptors are strictly protected in Israel, but despite the legal protection, several species have become extinct and others have undergone severe decline due to pesticide use, land use changes, human interference, low flights of aircraft, and electrocution. As part of the presented study and conservation program, retrofit insulation was installed to protect birds of prey, with emphasis on the most susceptible species, such as the Griffon vulture (*Gyps fulvus*). The program insulated over 3,500 22-33 kV poles and 160 kV transmission towers. Surveys were conducted before and after the implementation of the insulation devices, and a substantial reduction in avian mortality and a significant reduction of outages were observed. The paper also discusses the perspective of a utility and the cost of outages, and the importance of risk assessment, education and a collaborative approach in framing a long term and comprehensive solutions.

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Eagle Electrocutions in North America: Current Status and Mitigation Approaches

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Electrocution on power poles is a persistent problem for many raptor species around the world. In North America, electrocutions of Bald Eagles (*Haliaeetus leucocephalus*) and Golden Eagles (*Aquila chrysaetos*) are an ongoing management and regulatory issue. Despite widespread use of mitigation techniques to retrofit existing poles and to build new poles to avian-friendly standards, electrocution remains a leading anthropogenic cause of death for both eagle species. There are 8 risk factors identified for electrocution: pole design, eagle age, species morphology, habitat and topography, prey availability, season, weather, and behavior. Pole configuration is the most frequently identified electrocution risk factor for eagles, and electrocution incidents are most often associated with distribution level (< 69 kV) equipment poles. Risk modeling based on these factors can assist electric utilities in identifying high-risk poles at the regional scale and prioritize them for retrofitting. In the United States, new funding sources for retrofitting poles are becoming available to utilities from permittees required to complete compensatory mitigation for eagle take. Effective use of these funding sources and renewed regulatory focus on retrofitting are critical to a range-wide reduction of eagle electrocutions.

Managing Negative Interactions of Tasmanian Raptors with Power Infrastructure With a Focus on Endangered Wedge-tailed Eagles

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Collisions and electrocutions have replaced persecution as the major anthropogenic threats to Tasmanian raptors. Without eyewitness accounts or evidence of electrocution, it is often difficult to identify power lines as the cause of death, particularly for collisions in situations where fences and roads exist nearby (a usual combination). Over the past decade numbers of threatened raptors reported killed by overhead power infrastructure have increased from 7 to 33 per yr. These changes appear to be mainly due to increased public and utility awareness, because both the length of power lines (21,500 km) and abundance of eagles (from road counts) have increased only marginally

through that period, and because no systematic surveys are conducted. The number of incidents must be under-reported. To assess this, 17 carcasses of Wedge-tailed Eagles (*Aquila audax fleayi*), White-bellied Sea-eagles (*Haliaeetus leucogaster*) and Grey Goshawks (*Accipiter novaehollandiae*) placed under powerlines for two wks. None were reported to authorities. Tasmania's electricity distribution and transmission utility (TasNetworks) is obliged to report incidents with threatened raptors (4 of 13 Tasmania species) but can only do so if carcasses are identified. When outages occur, inspections are carried out by TasNetworks to determine the cause. Approximately 23% of outages are attributed to birds and 40% are classified as "cause unknown", some of which are likely also due to birds. To address this TasNetworks and the Raptor Refuge are following the partnership model between Eskom and the Endangered Wildlife Trust to develop a retrofitting program for poles and lines that have killed threatened raptors. The program will include a dedicated phone number and an app to report incidents, and include development of an Eagle Strike Risk Model that considers various risk factors (high eagle densities, landscape and infrastructure characteristics).

Global Factors Driving Bird Electrocution on Power Lines

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Interactions with power lines are one the most important causes of bird mortality worldwide. Electrocution is especially problematic for threatened species, particularly raptors. During recent decades, numerous studies have led to increasing understanding of the factors influencing risks of raptor electrocution. But until now, no work evaluated whether this knowledge was generated in a spatially homogeneous way, or identified the factors driving global patterns of avian electrocution. We reviewed a total of 114 studies and performed generalized linear modeling including information extracted from each paper. Our results showed a high spatial distribution bias, 82.5% of the studies were located in Europe (54.4%) or Asia (28.1%). Four factors were included in bird electrocution models, with a relatively homogeneous behavior: habitat, number of surveyed pylons, decade when the survey was conducted, and geographic coordinates. Group-specific factors concerning pylon design as the percentage of pylons with phases over the cross arm were included only in raptor electrocution models. Despite bird electrocution having been widely studied, there are large areas in which no study has been developed or data are inaccessible, such as large areas of Oceania, Asia, and Africa.

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** **William C. Andersen Memorial Award Candidate**

This could be because in these areas the electricity distribution network is scarce or be because electrocutions are undetected or unreported in those areas to date. Researchers and managers should promote the publication of their surveys, as the awareness is the first step to solving problems. Factors detected in raptor electrocution risk might be globally applied in power grid design and planning to identify existing mortality hotspots or to avoid creating new ones, especially in developing countries where new power lines are expanding rapidly.

Lessons to Improve Retrofitting: Quantifying Bird Electrocutions on Retrofitted Pylons (POSTER PRESENTATION)

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Despite efforts to retrofit existing pylons and construct new pylons according to avian-friendly criteria, raptor electrocutions on power lines remain substantial cause of death, and a global conservation concern. Retrofitting involving the installation of cover-up materials on energized equipment to prevent phase-to-phase and phase-to-ground contact, is effective when applied correctly, but electrocutions often persist after retrofitting. In this study, we provide the first analyses of raptor electrocutions on previously retrofitted pylons in Andalusia, Spain. From 1990 to 2017, nearly 9,000 high-risk poles were retrofitted, contributing to stopping the decline of the threatened Spanish Imperial Eagle (*Aquila adalberti*) and the Bonelli's Eagle (*Aquila fasciata*). However, in that period, 1,178 raptor electrocutions were recorded on 989 pylons. Of these, 150 electrocutions (12.7%) occurred on 97 retrofitted pylons (9.8%). We identified four categories of retrofitting problems. Degraded retrofitting equipment resulted in 38 raptor electrocutions on 17 pylons. Two of the Spanish Imperial Eagles and two of the Bonelli's Eagles we found electrocuted were on pylons with degraded retrofitting. Mitigation plan errors (failure to cover all dangerous locations) resulted in 20 electrocutions on 14 pylons. Removed retrofitting resulted in seven electrocutions on six pylons. Application errors (incorrectly installed retrofitting) resulted in six electrocutions on four pylons. Degraded retrofitting has not previously been considered in studies of post-retrofitting electrocutions. The degradation we observed was on correctly

designed and installed equipment, that cracked or was displaced over time. Though this occurred on only 1.7% of pylons, it poses a major concern because degradation will likely occur on similarly retrofitted pylons. Retrofitting programs must include a long-term maintenance component to address degradation. Specifically, electric utility personnel must be trained and equipped to identify and replace degraded retrofitting equipment before raptor electrocutions occur. Equipment manufacturers should also be encouraged to refine retrofitting products to maximize effective lifespans.

Falconers Against Electrocution of Birds of Prey

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Avian electrocutions affect raptors worldwide. Though falconers are sometimes implicated in these losses, the truth is that falconers work to address this important conservation concern. For example, falconers first noticed decline of Peregrine Falcon (*Falco peregrinus*) populations and warned scientists and conservation authorities. Falconers also contributed financing to studies that identified Dichlorodiphenyltrichloroethane (DDT) as the cause of this decrease, and supported calls for a global DDT ban. In support of the recovery of Peregrine Falcon populations, and of other raptor populations affected by DDT, falconers were first to breed falcons for reintroduction programs, and falconers contributed to developing strategies to intensify captive breeding programs. Falconry methods were subsequently used for other species, including California Condors (*Gymnogyps californianus*) and Mauritius Kestrels (*Falco punctatus*). Falconers also contributed to identifying diclofenac as the reason for Asia's declining vulture populations. Saker Falcons (*Falco cherrug*) are also in decline in Asia, and falconers have contributed to studies demonstrating that new medium voltage power lines are largely responsible, with a minimum 4,000 Mongolian Saker Falcons electrocuted annually. Falconers are now involved in finding solutions to this electrocution issue, including calling for the financiers of new electricity infrastructure to implement avian-friendly construction and mitigation practices.

Small Unmanned Aircraft Systems (UAS) Facilitate Assessment of Entanglement Hazards in Osprey Nest Platforms

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Osprey (*Pandion haliaetus*) regularly incorporate synthetic polypropylene baling twine in their nests. This can create entanglement hazards, particularly for nestlings, and when carried to power poles, can lead to power outages, equipment damage, fires, and Osprey electrocutions. Removing baling twine could alleviate these concerns, but assessment of the presence of baling twine within nest cups where entanglement hazards are greatest is precluded by the difficulty of viewing nest contents from below. To evaluate a new technique potentially useful in identifying baling twine in nest cups, we used a small unmanned aircraft system (UAS) to document the presence or absence of baling twine in 11 active and four inactive Osprey nests around Fort Collins, Colorado. Most nests included baling twine. To minimize entanglement hazards for Osprey, users of baling twine (and of other sources of trash Osprey incorporate into nests) should be encouraged to collect and appropriately recycle or dispose of waste materials. Electric utilities could also consider annual removal from or cutting of baling twine in Osprey nests. Using a small UAS to check nest contents prior to accessing nests may make this more feasible.



Cuckoo Hawk | Photo by André Botha



Secretarybird | Photo by André Botha

SYMPOSIUM II ABSTRACTS

Filling Knowledge Gaps in the Conservation of Old World Vultures

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The CMS Multi-species Action Plan to Conserve African-Eurasian Vultures (Vulture MsAP) aims to rapidly halt current population declines in all the 15 African-Eurasian vulture species. The Vulture MsAP has identified a range of knowledge gaps in terms of vultures and the threats that impact their populations across the range, especially in Africa. This one day symposium will invite presentations from delegates across the MsAP range and beyond to report on work that contributes towards filling these knowledge gaps, addresses pertinent threats and supports the successful implementation of the Vulture MsAP.

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Evidence that Two Distinct, Stable, and Significant Populations of African Vultures Persist in Southern Tanzania

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African vulture species are in danger of extinction with African White-backed Vulture (*Gyps africanus*), White-headed Vulture (*Trigonoceps occipitalis*), and Hooded Vulture (*Necrosyrtes monachus*) now considered Critically Endangered and Lappet-faced Vultures (*Torgos tracheliotos*) considered Endangered by the IUCN Red List (2016). In 2012 at the Pan-African Vulture Summit, southern Tanzania was identified as an area likely to be important for vultures, but where little was currently known about the status, population trends, or threats to vultures. In 2013, the North Carolina Zoo in partnership with the Wildlife Conservation Society began assessing vulture population status in Ruaha-Katavi National Parks. Recently in partnership with the Frankfurt Zoological Society, the North Carolina Zoo has extended this work to the Selous Game Reserve. While historical data are lacking, findings from six yrs of study suggest substantial and stable populations of several vulture species, particularly African White-backed Vultures, White-headed Vultures, and Hooded Vultures, in southern Tanzania. While Lappet-faced Vultures are less common in the region, numbers also appear stable. Since 2015, 26 Vultures have been tagged with satellite telemetry in southern Tanzania. Preliminary results from movement studies demonstrate that Tanzania has at least three separate populations of White-backed Vultures, two in southern Tanzania, and that poisoning does occur along the edges of protected areas due to retaliatory killing of lions and other carnivores, though possibly less frequently than in other regions. While hunting is common in the region, lead exposure does not appear to be a major issue, but further work is needed. In this presentation, we will share results from our Vulture research and conservation efforts in southern Tanzania to date.

Identifying Critical Migratory Bottlenecks and High-use Areas for an Endangered Migratory Soaring Bird Across Three Continents

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Migrant birds face a number of threats throughout their annual cycle, including persecution, collision with energy infrastructure, and habitat and climate change. A key challenge for the conservation of migrants is the identification of important habitat, including migratory concentration areas, because species survival rates may be determined by events in limited areas. Remote-tracking technology is facilitating the identification of such critical habitat, although the strategic identification of important sites and incorporation of such knowledge in conservation planning remains limited. We tracked 45 individuals of the Egyptian Vulture (*Neophron percnopterus*), over 75 complete migrations that traversed three continents along the Red Sea Flyway. We summarize and contextualize migration statistics by season and age class, including migration start, midpoint, and end dates, as well as linear and cumulative migration distance, migration duration and speed, and route straightness. Then, using dynamic Brownian bridge movement models, we quantified space use to identify the most important migratory bottlenecks and high-use areas on the flyway. These areas each accounted for 20% of all tracks passed through bottlenecks, and >50% of the overall time spent on migration fell within high-use areas. The most important sites were located at the southeastern Red Sea coast and Bab-el-Mandeb Strait (Saudi Arabia, Yemen, Djibouti), the Suez Canal zone (Egypt), and the Gulf of Iskenderun (Turkey). Discouragingly however, none of the area within the major migratory bottlenecks was protected and <13% of the high-use areas were protected. This demonstrates a very concerning gap in the protected area network for migratory soaring birds along the Red Sea Flyway. Because reducing threats at migratory concentrations can be a very efficient approach to protect populations, our work provides clear guidelines where conservation investment is urgently needed to benefit as many as 35 migratory soaring-bird species that regularly use the Red Sea Flyway.

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Mapping African Vulture Strongholds and Their Threat Levels to Inform Conservation Action

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In the face of widespread threats, the African Vulture Crisis is growing, while conservation efforts are being hampered by a lack of funds, manpower, and spatial information about Vulture population status and major threats in many areas. At present, the knowledge of the key breeding and foraging sites and threats to Vultures is very scant and largely anecdotal in many parts of the continent. Given limited resources for conservation action and the need to prioritize those areas where losses are potentially the greatest, threat mapping of Vultures in Africa was one of the main actions highlighted in the Multi-species Action Plan to Conserve African-Eurasian Vultures. With such information the somewhat slower rate of decline in Africa may allow NGOs and governments the time to reduce key threats to Vultures, thus avoiding the collapse of Vulture populations and its environmental consequences. We use visualizations of the distribution of African Vultures and the spatial distribution and intensity of threats to map areas of overlap. We utilize a vast amount of Vulture sighting and specimen data drawn from the African Raptor Databank (ARDB) together with GPS tracking for 228 tagged African Vultures of eight species representing > 6000000 km travelled by African Vultures collated across the continent to define areas of importance to breeding and foraging Vultures, and we overlay these with maps of the most significant threats, notably poisoning, trade and energy infrastructure. Our results allow Vulture conservationist to target with priority those areas where the situation is most critical. We highlight the importance of specific strongholds, countries and regions for Vulture conservation, and evaluate threat levels in each stronghold to inform effective conservation action directed at mitigating known or potential threats.

Possible Effects of Environmental Contaminants on Breeding Success of the Eurasian Griffon Vulture (*Gyps Fulvus*) in North Israel

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The population of the Eurasian Griffon Vulture at Gamla Nature Reserve in northern Israel is experiencing a severe decline, having dropped from 110 individuals in 2001 to 10 in 2018. The average breeding success at Gamla is about 30%, much lower than the average 70% reported in European countries. The low breeding success led us to the assumption that the vultures at Gamla may be exposed to sub-lethal, persistent and chronic factors such as endocrine disrupting contaminants. The possible exposure of the population to these contaminants may impair their fitness and could be considered as factors causing the decline, in addition to the known lethal ones such as acute poisoning. We collected 133 naturally shed flight feathers from vultures in Israel, Crete, Bulgaria, Italy, Spain and France for comparison. The chemical analysis of these feathers revealed the presence of over 100 contaminants such as organophosphates, carbamates and Bisphenol A. The analysis also revealed the presence of 10 veterinary drugs from the nonsteroidal anti-inflammatory drugs (NSAIDs) family, like diclofenac. The contaminants levels found in the feathers differed among the countries. The levels of contaminants such as Diuron, Fipronil and Carbaryl found in feathers collected in Israel were higher than the levels found in those collected in Europe. Some of the high-level contaminants such as Fipronil have a known endocrine disrupting effect. The analysis of samples gathered within Israel clearly revealed a residue pattern across three distinct geographic areas: The feathers from the Gamla area were characterized with high levels of Bisphenol A and Fipronil, the Carmel feathers with high levels of Oxamyl and Acetamiprid and those from the Negev with high levels of Metoxuron. The results suggest that exposure to contaminants may be associated with lower breeding success. We suggest considering this in the actions taken to mitigate the species' decline.

Tracking Vultures — Endangered Species Guiding Conservation Action in Zululand, South Africa.

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The tracking of the movement of vultures and such contribution to species conservation is well documented. Ezemvelo KwaZulu-Natal Wildlife and Wildlife ACT initiated a project in 2017 to track

the movement of adult African White-backed Vultures (*Gyps africanus*) in the Hluhluwe-Imfolozi Park in Zululand, KwaZulu-Natal. The project utilising GSM tracking units, although initially aimed to improve the understanding of resident breeding birds within the park, their biological parameters and utilisation of habitat space, has been able to guide conservation action within and outside of the Park. The movement of breeding birds varied according to season and distinct movement patterns are emerging. Tracking movement guides the placement of inappropriate linear development and will alert conservation practitioners to poisoning incidents as well as guiding the placement of appropriate vulture safe zones and protected area expansion opportunities in the Zululand region. The ability for conservation managers to utilise real-time tracking data to guide conservation action has become evident and Ezemvelo KwaZulu-Natal Wildlife is engaging its conservation partners to enhance this technology/conservation interface to ensure that the lifespan of this project is extended indefinitely.

Flight and Foraging Decision Making in Griffon Vultures

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Griffon vultures (*Gyps fulvus*) are obligate scavengers, facing many constraints while foraging. Their morphology constrains them to use soaring-gliding flight, dependent on local atmospheric conditions. They must search over large areas for carcasses, which are rather unpredictable in time and/or space, even if available at supplementary feeding stations. We review the latest discoveries of how Vultures cope with these trade-offs, by comparing movement patterns of individuals tracked by GPS telemetry and accelerometry in deserts in Israel and mountains in France. First we introduce the concept of triple trade-off faced by flying Vultures, managing time, energy and risk, to compare the flight strategies of Vultures during their outbound and inbound foraging trips. During inbound flights, individuals reduced journey time by performing more efficient soaring-gliding flight, reduced energy expenditure by flapping less and were more risk-prone by gliding more steeply between thermals. Second we investigated how food predictability and breeding status would affect foraging decisions by comparing Vulture behaviour in regions with and without feeding stations.

The flight parameters (time of departure from the roost, daily distance travelled, duration of flight bouts) were strongly influenced by wind and availability of thermal uplifts. Compared to non-breeders, breeding individuals in regions with more feeding stations spent more time flying per day, and also more time feeding when on the ground. Our results suggest that the breeding status of the individual, the seasonality of the availability of food resources, and the atmospheric conditions influence movement patterns and time and energy prioritization during flight.

Spatial-utilization Patterns by Captive-bred and Rehabilitated Cape Vultures (*Gyps coprotheres*) in Southern Africa

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Following the continual decline of Cape Vulture populations over the last 40 yrs, captive breeding and rehabilitation programs have been set up with the aim to restore populations across southern Africa. Released vultures from these programs are expected to demonstrate the same patterns of spatial ecology. This study aims to determine the effectiveness of these conservation interventions by highlighting the capabilities and behavioral similarities between our study groups. Our analysis incorporated 242,584 GPS tracking points from 21 captive-bred and 15 rehabilitated birds. Minimum Convex Polygon (MCP) and Kernel Density Estimation (KDE) methods were used to analyze the extent of home ranges with 95% and 50% contours. The Vultures travelled across the subcontinent into eight different countries with an overall MCP of 2,726,629 km². Findings suggest that home range was significantly larger for rehabilitated birds (median MCP = 88,882 km²) than for captive-bred birds (median MCP = 634 km²). Furthermore, there was no clear effect of time spent in captivity or the nature of injury sustained on post-release dispersal behavior. Captive-bred birds showed a higher level of site fidelity and remained close to their release site (median dispersal distance = 24.24 km), whereas rehabilitated birds dispersed more widely across their native range (median dispersal distance = 251.73 km). By remaining close to their release site, captive-bred birds maintained a significantly higher proportion of their GPS locations within protected areas than rehabilitated birds. Despite showing site fidelity, captive-bred birds demonstrated innate capabilities for natural foraging behaviors. These findings suggest that captive breeding could provide localized restoration benefits for declining colonies. Future long-term studies should seek to analyze

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survivorship and identify breeding behavior for these captive-bred birds once they reach sexual maturity.

Apparent Numerical Response of Obligate and Facultative Avian Scavengers to Annual Rainfall in Gorongosa National Park, Mozambique

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Wildlife populations in Africa have declined across the continent over the past century for a variety of reasons including rapid human population growth, land-use changes, habitat fragmentation, big game hunting, poaching, and war. Scavengers, particularly obligate scavengers, are dependent upon the regular availability of fresh carcasses. Gorongosa National Park, Mozambique lies at the southern end of the Great Rift Valley. The park was created in 1960 but suffered from exploitation of wildlife resources during a prolonged period of war, resulting in a greater than 90% reduction in large mammal numbers. The reduction of large mammal populations likely impacted populations of scavengers, such as vultures, and other large avian species. As part of park restoration activities, we set forth to assess the population status of vultures and other large raptors within the park. We created Project GLASS - Gorongosa Large Avian Species Survey - to 1) produce population size estimates with statistical power and rigor to track population trends of vultures and other large avian species over time; 2) assess temporal variation in abundance; and 3) assess factors influencing species diversity and abundance over time. We hypothesized that scavenger abundance would be positively associated with carcass availability, which in turn would be negatively influenced by rainfall. Here we present our early findings.

Upcoming Ken Betwa link Project (KBLP): A Threat to Breeding Sites of Vultures in Panna Tiger Reserve, Bundelkhand Region, India

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The Ken-Betwa River Interlinking Project (KBLP) will be the first river project that will be located within the Panna Tiger Reserve. KBLP proposes to divert the surplus waters of the River Ken through Ken Betwa Link Canal to Rier Betwa. This proposal includes construction of a dam across the Ken River upstream of the Gangau Weir. It will submerge about 10% of the Panna Tiger Reserve in Madhya Pradesh. After the dramatic decline in vulture populations over two decades, Panna is probably the only habitat that has emerged as a stronghold for approximately seven of the nine vulture species found in India. The terrain of high plateaus, deep rocky gorges, and grasslands provide the perfect habitat for vultures to breed. Almost 86% of nests of vultures are located on the rocks on the bank of the Ken River. Four vulture species- White-rumped Vulture (*Gyps bengalensis*), Indian Vulture (*Gyps indicus*), Red-headed Vulture (*Sarcogyps calvus*) and the subspecies of the Egyptian Vulture (*Neophron percnopterus ginginianus*) continue to breed on these cliffs. Griffon Vultures (*Gyps fulvus*), Himalayan Griffon Vultures (*Gyps himalayansis*), Cinereous Vultures (*Aegypius monachus*) and European Egyptian Vultures (*N. p. percnopterus*) are regular winter visitors. A census in January every yr from 2010 to 2014 has estimated a population around 1034 from 34 sites. The proposed river linking project will also submerge vast feeding, roosting, and bathing sites as well as 400 nests from nesting cliffs, including 60% of nesting habitat for four vulture's species. About 90 km² of forest will be submerged in the project and almost half of it comprises core area of the tiger reserve. Panna Tiger reserve is a home for vultures, and KBLP is a big concern for protecting habitat of vultures globally to help maintain a balance between ecosystems.

A clear and Present Danger: Impacts of Poisoning on a Vulture Population and the Effect of Poison Response Activities

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Vultures in Africa are being poisoned deliberately by poachers seeking either to prevent the birds alerting authorities to their illegal activities or to harvest and sell vulture body parts for witchcraft. Hundreds of vultures can be killed at a single poisoned elephant carcass and whilst field-staff trained in poison

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response activities (site decontamination and bird first aid) can limit the damage caused by poisoning events, mortalities are still high. We used the population viability analysis programme VORTEX to model six 100-yr long scenarios investigating the effects of different rates of poisoning mortalities on a globally important population of critically endangered African White-backed Vultures (*Gyps africanus*) breeding in Kruger National Park (KNP), South Africa. In five scenarios the vulture population declined. In three of these scenarios, the population survived over the 100-yr simulation but was reduced by 60-90%. In two scenarios, a single poisoned elephant carcass left untreated was modelled as a catastrophic event with a 50% probability of annual occurrence and this resulted in a 100% probability of population extinction, with a mean time to extinction of 52-53 yrs. Poison response activities were modelled as a 70% reduction of vulture mortality at each poisoned elephant carcass and resulted in population persistence after 100 yrs, but with an approximately 90% reduction in size (final n = 212). Our results highlight that while effective poison response activities will not prevent poisoning incidents from occurring, they form an essential and valuable part of wider conservation actions designed to prevent local extinctions of vulnerable species.

VISA – The Metadata Project Concept to Improve Connectivity for Vulture Research and Conservation

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Declining Old World Vulture populations has been a prominent feature of early 21st Century conservation. Despite gains in parts of Europe, in Africa the trend for vultures is generally downwards. In south Asia a possible stabilisation of vulture populations precedes an enormous workload to achieve a recovery. These scenarios led to the CMS Vulture Multi-species Action Plan (MsAP), a huge achievement that is a framework for conservation action and a summation of knowledge for Old World Vultures. There is thus no lack of knowledge about the threats facing vultures or the actions necessary to address them. But the MsAP contains over 124 separate actions under 12 wide-ranging Objectives. How do relevant stakeholders know who is addressing different actions? Which actions are in progress or are complete? As stakeholders we are all, to some extent, disconnected from activities in other areas. A continuous flow of new stakeholders exacerbates this lack of connectivity. Fundamentally, this is counterproductive because it can lead to duplication of effort or neglect of gaps in our knowledge. A point of connection enables measureable progress towards the MsAP objectives by

its target date of 2029. This presentation outlines a metadata project concept - the Vulture Initiative for sub-Saharan Africa (VISA) - that aims to increase connectivity between relevant stakeholders and reduce gaps in knowledge. VISA is not a list of tasks, nor a list of priority actions or a data collation initiative. It is aimed at connecting research outcomes and conservation actions whilst forming partnerships with a broad range of stakeholders concerned with wider issues of wildlife trade and ecosystem function that ultimately impact on human health and sustainability. Connected via an interactive open access portal with GIS support, VISA will run under the non-denominational and non-organisational umbrella of the IUCN Species Survival Commission's Vulture Specialist Group.

Wildlife Poisoning Response Protocol Training in Northern Kenya

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Wildlife poisoning is a serious threat to many species of African wildlife, but vultures and other avian scavengers such as Bateleurs (*Terathopius ecaudatus*) and Tawny Eagles (*Aquila rapax*) have been shown to be particularly vulnerable. The threat primarily arises from retaliatory poisoning of mammalian predators due to human-wildlife conflict. Starting April 2017 to date, we have trained local teams, including rangers and members of community-based organizations at key poisoning hotspots in Samburu and Laikipia counties in northern Kenya. This training aims to reduce incidences of poisoning and to reduce mortality at each incident. Trainees are educated about the dangers of wildlife poisoning and they learn how to rapidly respond to poisoning incidents, which reduces mortality. The results of our work include a total of 484 persons from 37 groups having been trained so far in rapid poisoning response. Further, post-training outcomes by our trainees include holding off poisoning of two troublesome prides of lions, disposal of at least six poisoned dog carcasses through burning, reduced pesticide and herbicide use in wetlands and pasturelands respectively, and increased interest in our training by county government as well as informal community forums.

Status and Conservation of South Asian Gyps Vultures

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In 1999 the alert went out from India of grave concern about the Oriental White-Rumped Vulture (*Gyps bengalensis*). Surveys across India in 2000 discovered that there had been a 96% decline since 1992 in that species and a 93% decline in two other *Gyps* species endemic to South Asia (*Gyps indicus* and *Gyps tenuirostris*). Adjoining countries also reported declines. In 2004 the cause of the catastrophic declines was found to be diclofenac, a Non-Steroidal Anti Inflammatory drug (NSAID), licensed in the late 1980's as a veterinary drug in widespread use in the mid-1990s. By 2000, millions of doses were given yearly to cattle in India alone and in 2004-2005 over 10% of cattle carcasses available to vultures had traces of the drug. Diclofenac causes kidney failure and rapid death in all *Gyps* vulture species tested so far. International conferences to discuss the declines and actions were held in Nepal and India in 2004 leading to plans for action: banning veterinary use of diclofenac; building suitable facilities and capacity to establish conservation breeding for all three species; monitoring populations; finding safe alternative to NSAIDs for veterinary use and testing all NSAIDs for vulture safety. After a few years, a need for improved international co-ordination of these activities was identified, and the international vulture conservation consortium Saving Asia's Vultures from Extinction (SAVE) was founded in 2011. In 2019 it is two decades on from the original alert. This paper describes what has happened since, where we are now with the conservation of the three species of *Gyps* vultures, and what continuing conservation concerns there are for South Asian Vultures.

Cliff Characteristics, Neighbor Requirements and Breeding Success of the Colonial Cape Vulture

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The Cape Vulture (*Gyps coprotheres*) is a globally threatened species that is endemic to southern Africa and has seen a major reduction in its population size. Factors that influence the occupancy and breeding success of individual nest-sites are not fully understood for any African vulture species. We investigated cliff characteristics and neighbor requirements of the Msikaba Cape Vulture colony, a major breeding colony in the southern node of the population in the Eastern Cape, South Africa, together with their nest-site occupation and breeding success

over 13 yrs. In total, 1767 breeding attempts were recorded. Nest-sites that had a higher elevation, smaller ledge depth, greater total productivity, and were surrounded by conspecifics were more likely to be occupied, although the amount of overhang above the nest was not an important predictor of occupancy. In accordance with occupation, nest-sites with a smaller ledge depth had higher breeding success; however, nests with a greater overhang were also more successful and height of the nest-site was not an important predictor of breeding success. The breeding success of a nest-site in a given year was positively influenced by the number of direct nest neighbors, and nests in the middle of high-density areas had greater breeding success. This suggests that maintaining a high nest density may be an important consideration if declines of reproducing adults continue. Breeding success declined over the study period, highlighting the effects of a temporal variation or observer bias. Our results identified optimal nest-site locations (ledge depths of 1 m, at a height of 180 m) and their effects on breeding success.

What's in the Numbers? 10 Years of Tree-Nesting Vulture Surveys in Zululand, KwaZulu-Natal (POSTER PRESENTATION)

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Ezemvelo KwaZulu-Natal Wildlife has been conducting aerial surveys within the Zululand region of KwaZulu-Natal, South Africa in fulfillment of their mandate as the provinces custodian of Biodiversity since 2009. Lappet-faced Vulture (*Torgos tracheliotos*), African White-backed Vulture (*Gyps africanus*) and White-headed Vulture (*Trigonoceps occipitalis*) are the three key species for which nesting and breeding productivity have been recorded. The distribution of all three species has remained somewhat static and restricted to declared Protected Areas or secured game farms, with a consistent survey effort throughout the period. Nesting sites of African White-backed Vultures have increased during the survey period, more specifically within the Tula Tula Private Game Reserve. There has been little to no change in Lappet-faced Vulture sites but a marked decrease in the number of active White-headed Vulture nests being recorded during the survey period. Breeding productivity for all three species does not demonstrate any significant trend, although African White-backed Vultures may be more successful than the other two species. The 10 yr review of the survey data also provides for a review of the survey technique and results, and

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we critically analyzed the effectiveness of a fixed wing aerial survey of the study area. The outcomes of the aerial allowed for Ezemvelo KwaZulu-Natal Wildlife to monitor vulture populations in the province and guide development into less sensitive environments.

Africa's First Continental Wildlife Poisoning Database Two Years On (POSTER PRESENTATION)

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The use of poisons to kill wildlife has increased dramatically over the past two decades. Poisoning is the main threat to critically endangered African vultures and has severely impacted populations of many other species, including Lions (*Panthera leo*), Hyenas, Tawny Eagles (*Aquila rapax*), Bateleurs (*Terathopius ecaudatus*) and Jackals. In 2017, the Endangered Wildlife Trust and The Peregrine Fund partnered to combine regional records of poisoning incidents into one continental database to monitor trends and better understand the drivers of wildlife poisoning. The African Wildlife Poisoning Database is now online (africanwildlifepoisoning.org) to allow users to input records of incidents, as well as to view basic spatial and species data. More comprehensive data is available upon written request. The database currently contains records of 451 poisoning incidents involving 15085 mortalities of 59 wildlife- and four domestic species. The majority of mortalities were in East Africa (n = 7636), closely followed by Southern Africa (n = 7399). A small number of mortalities, 37 and 13, are recorded in the database for West and Central Africa respectively. The largest number of mortalities for a single species have been recorded for African White-backed Vultures (*Gyps africanus*) (n = 4763). While the reason for poisoning is unknown in many incidents (n = 152), conflict with wildlife was also identified as a major reason (n = 212), predominantly linked to predation of livestock and occasionally to crop damage. Over the past 23 mos, we have received nine requests for comprehensive data. The stated uses of the data have been mostly for research and conservation planning purposes, for example to inform the Multi-species Action Plan to Conserve African-Eurasian Vultures. Our aims are to upgrade the current online platform, translate the interface into French, finalize development of an app for field-based entry, and solicit records more widely.

Movements of White-headed Vultures and White-backed Vultures from Gorongosa National Park, Mozambique

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Decades of war and poaching decimated wildlife populations in Gorongosa National Park (GNP), Mozambique, but since 2005 recovery efforts have led to numerous conservation successes. Robust law-enforcement efforts, plans for expansion of the 4000 km² protected area and its scope of influence throughout the country make GNP an important location for Vulture conservation efforts. While the historic and current states of Vulture populations in the area are not well known, the park hosts apparently healthy populations of five Vulture species, the most common of which are the White-backed Vulture (*Gyps africanus*) and White-headed Vulture (*Trigonoceps occipitalis*). During May 2016, June 2017, and June 2018, we fitted a total of 12 White-headed and eight White-backed Vultures with GPS-Argos backpack transmitters with the primary goals of assessing home range, habitat use, and foraging hotspots. We also aim to compare the two species in an effort to contextualize White-headed Vulture movements. Here we present preliminary findings on breeding season home ranges, utilization of resources within and outside the protected area, and insights into foraging ecology.

The Reintroduction of Bearded Vultures in Europe – Background, Context, Results, and Recommendations from One of the Greatest Wildlife Comebacks of Our Times

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The Bearded Vulture (*Gypaetus barbatus*) is one of Europe's rarest vultures. In the 1980s a population existed in the Pyrenees (currently holding 150+ pairs), and two small island populations in Crete (7 pairs at present) and Corsica (5 pairs now). In 1986, the Vulture Conservation Foundation and other

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partners initiated an ambitious project to reintroduce the species in the Alps, based on releasing young birds from a captive breeding network managed by the VCF. The network currently maintains 190 captive birds distributed in 40 centers, such as captive-breeding centers, zoos, and animal parks. Today the return of the Bearded Vulture to the Alps is one of the most successful and celebrated wildlife comeback stories in Europe: there are 50 established pairs that last year fledged 31 young, and the population is rapidly increasing in France, Switzerland, Italy and Austria. Releases are still continuing there to increase genetic variability, and all prospects suggest a continued slow increase. Subsequently, a similar reintroduction project was started in Andalucía 12 yrs ago, with the first breeding in the wild happening in 2015. Eight yrs ago we started a reintroduction project in the Grands Causses-Cevennes, precisely to try to link the natural Pyrenean population with the reintroduced increasing alpine one. Then this year we started a fourth reintroduction project in Maestrazgo (Spain), to promote the connection and linkages between the Pyrenees and the Andalusian population. These four reintroduction projects (Alps-Andalusia-Grands Causses-Maestrazgo) can be seen as parts of a wider strategy to restore the species in Western Europe, by establishing a metapopulation linking southern Spain with the Pyrenees, the Cevennes, and the Alps. Once these populations are secured and effectively linked through gene flow, then it would be time to focus on reintroducing and restoring the species from the Alps down to Crete.

Variation in Monthly Home-Range Size of Hooded Vultures in West, East and Southern Africa

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We tracked the movements of 30 Hooded Vultures (*Necrosyrtes monachus*) of various age classes that were caught and fitted with GPS platform transmitter terminal units in Botswana (n = 5), Ethiopia (n = 4), Kenya (n = 4), Mozambique (n = 1), The Gambia (n = 4), and South Africa (n = 12). A total of 422,366 GPS fixes were accrued over 604 'bird-months'. This dataset comprises the first pan-African movement ecology study for this critically endangered species. We present mean monthly home range sizes for our tracked birds, estimated using minimum convex polygons and kernel density estimators. We determined the effects of various parameters on monthly home range size using mixed-effect models. Juvenile Hooded Vultures had the largest home ranges (for all three measures of home range size), followed by sub-adults and then adults. There was no difference in monthly home range size between the breeding and non-breeding seasons. Birds tagged in populations considered to be commensal had much smaller monthly home ranges than non-commensal conspecifics. Mean monthly home ranges of Hooded Vultures tagged in southern Africa were the largest, followed by those tagged in East and then West Africa. We discuss possible reasons for these differences, and whether it is necessary to track birds for their entire lives, or whether there is a cut-off point at which one can assume the cumulative home range size to have reached an asymptote. These results highlight the need for cross-border collaboration in conservation efforts, and they support the recent genetic work that suggests differences between regional populations.



Bateleur | Photo by Bill Clark

SYMPOSIUM III ABSTRACTS

Urban raptors: Understanding the Response of Avian Predators to Global Urbanization

Chair: Petra Sumasgutner, petra.sumasgutner@univie.ac.at



With the majority of the world's human population now living in urban areas, the impact of urbanization on biodiversity continues to grow. Wildlife populations in urban areas may be affected by habitat loss and fragmentation, altered biogeochemical cycles and the introduction of novel urban stressors such as light, noise and air pollution, nutritional changes, disease transmissions and the introduction of predators like domestic pets. However, some adaptable species, including raptors, are able to make use of abundant resources in a city, but there might be hidden costs of urban living which could undermine their long-term health and persistence in an urban environment. Declines in raptors and other apex predators are contributing to the global biodiversity-loss crisis, as apex predators can have cascading effects at the ecosystem level. With these issues in mind, this symposium will focus on understanding the mechanisms underlying the response of avian predators to global urbanization, from individual behavior to population dynamics and large-scale spatial distribution. Given the current biodiversity crisis, there is an urgent need to understanding the key factors driving species abundance and distribution at large-scales.

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The Cooper's Hawk (*Accipiter cooperii*): An Indicator of Urban Environmental Contamination

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Among the stressors confronting urban wildlife, chemical contaminants pose a particular problem for high trophic feeding species. Cooper's Hawks now inhabit urban environments across North America. Data from fortuitous carcass collections revealed surprisingly high levels of persistent organic pollutants (POPs), particularly brominated flame retardants, in hawks from urbanized areas of southwestern British Columbia, Canada. That led to a focal study in 2012 and 2013 that measured POPs in blood samples from adult and nestling Cooper's Hawks in the urban area of Metro Vancouver. Elevated levels of some POPs compounds were negatively associated with reproductive success and a health biomarker, circulating thyroid hormone levels. Most recently we have used the Cooper's Hawk as a model species to study bioaccumulation of POPs in terrestrial systems, which are understudied and processes not well understood compared to aquatic systems. Focused again on the Vancouver region, we collected a single egg from Cooper's Hawk nests over a range of urban habitats. We sampled the hawk's food chain by collecting samples of common prey species, American Robins (*Turdus migratorius*), European Starlings (*Sturnus vulgaris*), Sparrows and Doves. To represent the lower trophic levels, several species of Ground-beetles, Sow and Pill Bugs, Earthworms, and Blackberries were sampled. Soil and air samples also were collected near the Cooper's Hawk nesting sites. All samples have been analyzed for a wide range of contaminants listed as priorities by the Chemical Management Plan of the Canadian federal government. Resulting data will be inputted into a food-web model to examine terrestrial bioaccumulation processes.

Nesting Behavior of Suburban Red-shouldered Hawks (*Buteo lineatus*) in Southwestern Ohio

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As part of a long-term study on the ecology of suburban and rural Red-shouldered Hawks, we used video cameras to

monitor behavior of suburban hawks during incubation and the early nestling-rearing phase. We found that hawks laid eggs at intervals averaging 2.9 ± 0.1 d ($n = 28$ intervals). Red-shouldered Hawks exhibited partial incubation, incubating only some of the time during the laying period. Full incubation generally began with the laying of the penultimate egg, but was occasionally delayed until the laying of the last egg; this partial incubation behavior reduced but did not eliminate hatching asynchrony. Hatching intervals averaged 0.6 d between the first and second nestling, 1.2 d between the second and third nestlings, and 2.4 d between the third and fourth nestling. Hatching asynchrony advantaged the older nestlings, which were fed more than younger ones and were more aggressive toward their siblings. The amount of nestling aggression was significantly correlated with brood size, age, and nestling hatch-order rank. No direct sibicide was recorded, but two of the youngest nestlings in broods died after being repeatedly excluded from feedings ($n = 2$ nests of 25 monitored). Other causes of nest failure or nestling mortality included predation by Great Horned Owls (*Bubo virginianus*; 6 nests) and Raccoons (*Procyon lotor*; 2 nests), interference by Eastern Gray Squirrels (*Sciurus carolinensis*; 2 nests), falls from the nest (3 nests), and loss of one parent (2 nests). Populations of Raccoons and Gray Squirrels are denser in suburban than in rural, natural areas, suggesting a potential cost to hawks inhabiting suburban environments. However, long-term reproductive rates of these suburban hawks equal those of their counterparts in nearby, more-natural forests, and other measures also indicate that Red-shouldered Hawks are well-adapted to suburban life in southwestern Ohio.

Feeding Ecology of Indian Eagle Owl (*Bubo bengalensis*) (Franklin, 1831) in Lucknow, Northern India

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A study was conducted to reveal the ecological interaction

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existing between the prey and predator. The aim of the study is to unravel the prey spectrum and prey selection by the Indian Eagle Owl. Surveys were carried out in district Lucknow (26.8467° N, 80.9462° E) from February 2016 – April 2018. The most of the landscape of Lucknow is agricultural plain and scattered forest areas. Sub-tropical monsoon- type of climate prevails over here. River Gomti flows through this area. Pellets were collected from different sites in the study area. Biomass (Quantitative percentage) of food ingested was measured by dry weight analysis. In order to assess the potential prey (Murids' population), Standard trapping method was adopted. Trapping of small mammals reveals no significant seasonal variations in their population. A total of 1231 prey items were identified from pellets and carcass remains, accounting for a biomass (dry weight) of 63,742.27g of which mammals accounted for an estimated biomass of 86.4% of which rodents held with 67.42%. Indian Gerbil (*Tetera indica*) 27.07%, Black Rat (*Rattus rattus*) 22.67%, Lesser Bandicoot Rat (*Bandicota bengalensis*) 11.60%, and Northern Palm Squirrel (*Funumbulus pennanti*) 0.50% attributed foremost rodent food while Indian Hare (*Lepus nigricolis*) 18.03%, Bats (*chiropterans*) 0.95% and Asian House Shrew (*Suncus murinus*) 0.45% were other mammalian prey base. Birds were virtually significant non-mammalian prey item which formed a source of constant food succeeded by Frogs (anurans) 3.20% and reptilians 3.05%. Arthropods 0.26% accounted for only a small portion of biomass consumed. This study might confirm the niche components supportive of Indian Eagle Owl populations.

Costs and Benefits of Urban Living in Eurasian Kestrels

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As the world experiences rapid urban expansion, natural landscapes are being transformed into cities at an alarming rate. Urbanization leads to habitat fragmentation and increased impervious surfaces affecting for example availability and quality of food. Urbanization is also associated with increased pollution levels that can affect organisms directly and indirectly. Birds are highly mobile, while an individual is not necessarily exposed to

urban stressors around the clock, but nestlings of altricial birds are. Such a city-dwelling species with a long nestling phase is the Eurasian Kestrel (*Falco tinnunculus*) in Vienna, Austria, which forages on a diverse diet. Prey items vary in nutritional value and contents of micronutrients like carotenoids, which might impact health. In nestlings, carotenoid pigments function in parent offspring communication or sibling competition by advertising an individual's condition. Anthropogenic disturbance and pollutants could have disruptive effects on the coloration of these traits. In this study, we measured carotenoid based coloration and other indicators of individual health (body condition and susceptibility to the ectoparasite (*Carnus hemapterus*)) of 154 nestling kestrels (n = 91 nests) along an urban gradient from 2010 to 2015. We found skin yellowness of nestlings from the city-center to be least pronounced. This result might indicate that inner-city nestlings are strongly affected by urban stressors and depleted their stores of dietary carotenoids for health-related functions. In addition, skin yellowness intensified with age and was stronger pronounced in earlier nests. Since the immune system of nestlings is still developing, younger chicks might need more antioxidants to combat environmental stress. Additionally, parasite infection intensity was highest in nestlings with less intense skin yellowness, and in earlier nests of the season. In combination with results from previous studies, our findings provide further support for the low quality of the inner-city habitat, both in terms of productivity and individual health.

Understanding the Response of Peregrine Falcons to Increasing Urbanization and Climate Change

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Urban development is increasing across the globe and poses a major threat to biodiversity, which is often reduced in human-modified landscapes. Africa is currently experiencing the highest human population growth rate in the world, especially in urban areas. The continent is also likely to suffer significantly from climate change in the future. Thus, animals living in many parts of Africa will face the combined challenges of increased urbanization and climate change. The Cape Peninsula, South

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Africa, is located on the south-western tip of the African continent, where climate change is predicted to be particularly rapid and severe. This talk focuses on how Peregrine Falcons (*Falco peregrinus*) might respond to increasing urbanization under climate change. On the Cape Peninsula, the population of individually color ringed breeding pairs has been monitored over 30 yrs during which the density has increased markedly. We used this long-term data set to investigate the effects of urban-living and weather conditions on breeding phenology, reproductive success and adult survival. Our aim is to investigate the relative strength of these two important anthropogenic drivers of environmental change and help predict how species might adapt to these changes in the future.

Density Dependent Effects on Survival in an Urban-nesting Population of Cooper's Hawks

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When the density of animals of a given species increases, their average survival and productivity often decline. The underlying mechanism that causes these “density dependent effects” is generally unknown. Potential explanations include increased interference among breeding individuals, food depletion, and the timing of occupancy of high and low quality habitat. Our objective was to assess whether survival in an increasing population of urban-nesting Cooper's Hawks (*Accipiter cooperii*) declined over time and if survival was related to age, sex, or environmental factors. We captured and re-sighted Cooper's Hawks at their nests between 1994 and 2013 in Tucson, Arizona, USA. We used Cormack-Jolly-Seber to estimate apparent annual survival (ϕ), adjusted for recapture probability (p). We then used a sequential approach to identify the best model relating survival to age, sex, survey effort, temperature, precipitation, disease, nest site quality, and nest density. The number of known occupied nests in the Tucson area increased from 23 in 1994 to 163 in 2011. We marked 2169 Cooper's Hawks during this period. Recapture probabilities were high for adults (mean = 0.81) and lower for subadults, particularly males. Survival of adults was high, and varied little between females (0.81) and males (0.79). Estimates of subadult survival were lower than those of adults. Effects of weather on survival varied with age. Survival of subadult hawks decreased with increases in December precipitation. We found strong evidence of a negative density-dependent effect on overall rates of survival after accounting for age, sex, and weather. We also found evidence that survival of breeding hawks

was positively associated with nest site quality, supporting the idea that the density dependent effects on survival we found were at least partly due to the rates of survival of hawks occupying lower quality nest sites.



Martial Eagle | Photo by André Botha

SYMPOSIUM IV ABSTRACTS

How the Social Sciences are Adding Value to African Vulture Conservation

Chair: Dr. Jen Shaffer, lshaffe1@umd.edu



The U.S. National Science Foundation formed the National Socio-environmental Synthesis Center (SESYNC) to convene teams of social and environmental scientists to produce actionable conservation measures. A current project entitled “Saving Africa’s Vultures” has been formed with members from Kenya, South Africa, and the U.S. who are working on value-added tools for vulture conservation in Africa. This symposium will introduce raptor researchers to new tools and viewpoints from the social and environmental sciences, based on our current work in our SESYNC group. Talks will focus on wildlife trafficking and poaching, conservation ethics, use of vulture parts in belief systems, the concept of One Health, use of the Open Standards Model, and conservation leadership both formal and informal.

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Raptor Poaching and Trafficking: Global Trends and Crime Prevention Opportunities

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Around the world, poaching and trafficking of wild flora and fauna continues to converge with criminality; wildlife trafficking is estimated as the 4th largest illicit market in the world. Raptors are somewhat unique among the thousands of species that are trafficked. Raptors face threats from direct poaching and being trafficked alive (e.g., for falconry) or for their parts (e.g., for muti). They also face indirect threats when they consume poached animals laced with poison specifically to deflect law enforcement detection (e.g., elephants). This presentation uses conservation criminology as an interdisciplinary framework for profiling key trends in raptor poaching and trafficking. By beginning to delineate hotspots, source/transit/destination markets, supply chain routes and human dimensions, we offer baseline information profiling noteworthy trends. We consider the conservation, criminology, and risk science dimensions of these trends, highlighting criminal touch points including transnational crime, smuggling, corruption, burglary and gambling. Using the case of Vulture poaching and trafficking in southern and western Africa, we apply principles of situational crime prevention (SCP) to propose short-term fixes. SCP offers 25 strategies and tactics for reducing the opportunity for specific crimes to occur; the approach has never before been applied to raptor-related crimes. When combined with other strategies such as building law enforcement capacity, social marketing and policy changes, crime prevention strategies may contribute meaningful outcomes to raptor conservation in the face of on-going threats from poaching and trafficking.

Vulture Belief Use and Conservation Ethics

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Vultures provide important ecosystem services by removing waste, controlling disease, and recycling nutrients. In sub-Saharan Africa, these raptors also provide extensive spiritual and

cultural services such as connecting people to their ancestors, co-participating in rituals, and serving as key ingredients in traditional African belief-use practices. Connected to these “services” is a rich indigenous knowledge heritage highlighting the interconnectedness and interdependence of all organisms, plant or animal, which grounds an orally-based, system of African ethics. The popularity of this loosely acknowledged belief system among local peoples has significantly waned during the past century and/or is found to be syncretically intertwined with Christian and Islamic beliefs. Vultures, seen by many cultural groups as portents of the present and future, represent one small part of the complexity of the various values this belief system has brought to African peoples. The cultural services and spiritual symbolism offered by these raptors also helps shape the basis of a transcendent moral code found in many indigenous groups. As a microcosm representing the holistic nature of traditional belief systems, the collapse of Africa’s vulture populations could reveal devastating impacts on ecological, cultural, economic, and human-health systems. Several anthropogenic drivers currently threaten Africa’s vulture species with extinction, and recent estimates attribute 29% of population declines to the belief use trade. Herein, we review the literature to explore the cultural ecosystem services and traditional belief values vultures provide to sub-Saharan cultures. We document market observations of vultures sold for traditional belief use (e.g., muti, vodun). Our analysis highlights African vulture ethno-ornithology; identifying knowledge gaps and illuminating opportunities to work with communities and cultures to protect these threatened species, and reinforce the value of the ecosystem and cultural services and ethical guidance they provide.

The Sub-Saharan African Vulture Initiative: Using Open Standards for the Practice of Conservation

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Vultures face many threats, from expanding agriculture and infrastructure to direct poaching. Many agencies and NGOs in Africa are facing these challenges head-on. Recently, a multi-national project, entitled “Saving Africa’s Vultures”, was initiated through the National Socio-Environmental Synthesis Center in

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Annapolis, Maryland, USA that was funded through the National Science Foundation and the University of Maryland. In 2017 an interdisciplinary team of vulture and raptor experts were selected to guide the project. Currently the team is implementing the Open Standards Model for the Practice of Conservation to address the large and complex issues surrounding sub-Saharan vulture conservation. Open Standards is a well-established process of adaptive management and implements results-driven design, management, and monitoring that can significantly improve the outcomes of conservation efforts. We will explore the general Open Standards process and what makes it unique and appropriate for vulture conservation. Then, we will discuss the results of the on-going first two steps of the Open Standards process, including the identified team members, the project scope, and overall vision. We will address the group's identification of project-specific targets and primary threats to vultures. Lastly, we will conclude with the current status of the project, the next steps for 2019, and the complexities of tackling such a large conservation effort within this framework.

The Interdependence of One Health and Vulture Populations

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One Health brings together the powerful interrelationship and interdependence between human health and wildlife health; vultures being critical to a healthy socio-ecological system. Achieving an understanding of the complexities of factors affecting vulture and human health requires a multidimensional approach that integrates metrics of health, stressors, disease incidence, societal pressures and environmental factors. We explore and coalesce the dimensions of One Health as an integration of lifetime exposure to environmental stressors and health metrics as predictive indicators for vultures and humans. Component areas that provide insights into these complexities involve understanding key health measures and the impacts of stressors, such as overall physical health, immune, metabolic and endocrine function as well as measures of impacting factors, such as nutrition. The microbiome is emerging as a critical component of health and resilience across taxa. There

are numerous datasets that can be compiled and subjected to analytics that provide insights into animal movements, individual characteristics and environmental factors such as contaminants and habitat change. Ecotoxicology and environmental factors contributing to lifetime health and productivity are essential in understanding dynamic changes in populations and species. Ethnographic exploration of community environmental knowledge reveals local perceptions of important human-wildlife relationships, as well as identifies impacts and additional sources of societal and environmental stress affecting the larger socio-ecological system. Finally, forensic sciences provide essential tools in determining causal relationships and for identifying pivotal aspects of the interrelationship and interdependence of One Health and conserving healthy vulture populations. The challenge of integrating societal needs with maintaining healthy vulture population will preserve One Health for both human and wildlife populations and ensure ecosystem health as habitat and climate exert additional stress on all populations.

Traditional Uses of Vulture, Reducing Anthropogenic Impacts, Improving Attitudes, Promoting Sustainable Use and Reducing Declines (POSTER PRESENTATION)

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Birds are the world's second most threatened class in Animalia, after mammals. Threats to birds across the world are numerous and include climate change, exploitation for human benefit, habitat loss, invasive species and diseases. Large bird species are the most vulnerable as they are known as high value animals, particularly Vultures. Today, 39% of Vulture species worldwide, are listed by the International Union for Conservation of Nature as Critically Endangered. Sub-Saharan Africa is one of the highly affected regions. Vultures in this region are predominantly threatened by direct and indirect poisoning. Poison is indiscriminate and often catastrophic, killing a large number of birds including breeding individuals in one occasion. For example in 2012, 144 Vultures died after feeding on a poisoned Elephant (*Loxodonta africana*) carcass in Zimbabwe. Loss of Vultures to poisoning incidents is often far-reaching as it may involve breeding individuals, imperiling the viability of populations. Evidence reveals that Vultures are killed in this manner to prevent them from alerting the guards of poaching activities, particularly

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those involving ivory and or Rhino horn. However, in several occasions Vultures have been discovered next to Elephant carcasses with missing beaks and feet among other body parts. The parts are allegedly sold to traditional healers and or muthi traders to be further used for traditional medicine and magic related purposes. The exploitation of Vultures for traditional medicine is widely known. However, this phenomenon remains poorly understood and its impacts on Vulture populations is unknown. Nevertheless, some evidence exists to suggest that the use of Vultures in traditional medicine could present one of the main causes of Vulture declines in South Africa. In light of this, work has been proposed to seek an effective and practical intervention that can be applied to conserve vultures while also conserving traditional belief systems.

Understanding Conservationists' Perspectives Concerning the Ethical Dilemmas Associated with Declines in African Vulture Populations (POSTER PRESENTATION)

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Several African Vulture populations are declining due to many anthropogenic causes. This research explored viewpoints of conservationists to identify what are the main ethical dilemmas they face and from that information extrapolate potential solutions that balance both the needs of the vultures and the welfare of the impacted societies. To gain knowledge of conservationists' perspectives, an interview consisting of two parts took place: A Q-Methodology activity and a semi-structured interview. The Q-Methodology used statements in a ranked system to discover what the participant found most important. The follow up semi-structured interviews allowed for a more in-depth understanding as to the reasons why the respondents ranked the statements as they did. These two steps addressed not only what the subjects believed, but why they believed it, a key element in uncovering the ethical standpoints of the respondents. One of the major findings demonstrated that overall, the conservationists held a deontological, or duty-driven, point of view that drives them to pursue work in the field of conservation. This study identified ethical dilemmas that pose challenges in pursuing conservation actions. Exploring the different views of conservationists familiar with the African

Vulture decline is the first step to creating effective and ethical environmental policies to save the Vultures.

Determining the Drivers and Extent of Poisoning Among Pastoralist Communities in Southern Kenya

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In the south rift region of Kenya, wildlife poisoning is a serious threat to iconic African species such as Lions (*Panthera leo*), Leopards (*Panthera pardus*) and Hyenas. Vultures are severely affected by this practice leading to accelerated population declines in southern Kenya as well as across the whole of Africa. Vultures provide key ecosystem services, and their extinction will have devastating effects on the wider social-ecological system of the savanna. Given that human activities are the primary cause of the decline, it is important to understand the drivers and extent of illegal behaviors threatening wildlife. Here we study the drivers of poisoning and quantify the extent and distribution of this practice across southern Kenya. We focus on the two Counties of Narok and Kajiado known to support African Gyps Vultures . We gathered a total of c.1500 questionnaires where questions related to farming, livestock losses, issues with predators, and use of poison were asked to a random sample of pastoralists from across the area. The latter question is sensitive, therefore we used specific techniques, the unmatched-count technique, specifically designed to yield reliable answers from sensitive questions. Preliminary results suggest that < 1% of respondents use poison to kill predators in retaliation to livestock depredation. Modeling of the drivers of poisoning will be done in order to deeply understand the socio-ecological context in which pastoralists revert to poisoning. Finally, a map showing the hotspots of poison use will be derived based on the collected data and will be used to prioritize conservation actions where they are needed the most.

Human Perceptions of and Threats to Vultures in Ethiopia

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Vultures are the most threatened group of birds in the world. Ethiopia is regarded as an important stronghold for vultures in Africa, yet the status and threats to Vultures are not well documented here. To understand the human perceptions and threats to Vultures, 153 questionnaires were conducted in the country. The interview was conducted at abattoirs and residents nearby the abattoirs. There were 120 male and 33 female respondents whose age group was between 16-70 yrs old from different professions, ethnic, and religious groups. The public attitude towards Vultures in Ethiopia is positive, 98% of the respondents replied that Vultures are useful in cleaning the environment, because they feed on the waste and left over at the abattoir. The result showed that there are threats of vultures. We identified little evidence (2% of the respondents) that some parts of the Vulture are used for cultural purpose, such as medicinal value. Out of the 153 respondents 55 of them said that Vultures are found dead at the abattoirs and near the abattoirs. About 43.6% of the Vulture mortality was because of electric power lines. Power lines are problem for Vultures, as these constructions are rapidly increasing in Ethiopia, and Vultures can die from collision or electrocution with them. The Vulture mortality because of poisoning from feral dogs was found about 21.8%, and 34.5% of the death of Vultures was indicated because of accident such as road kill, ageing, and killed by children. The result showed that poisoning and electrocution are threats for the vultures. Since there is persecution and poisoning of Vultures in the country, there is a decline of Vultures due to the threats. Therefore, this study indicates that more research should be undertaken to explore more about Vultures in the country.

Using Social Science Techniques to Understand and Quantify Wildlife Crime

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Effective nature conservation in human-dominated landscapes requires understanding human behaviors, perceptions and values. Social science techniques have been developed to quantify sensitive behaviors, such as illegal practices. These techniques typically allow a certain degree of anonymity in the response, thereby protecting the respondent and yielding

more robust estimates of the real prevalence of behaviors compared to direct questioning. Such techniques are now being employed in conservation, e.g. to quantify wildlife crimes or other activities threatening biodiversity. I will briefly introduce the most popular social science techniques applied in conservation to address wildlife crime. I will then present results of studies from Namibia where one of these techniques, the Randomised Response Technique, was used to quantify illegal use of poison by communal and commercial farmers. Poisoning is used by farmers in retaliation to kill carnivores, and can have catastrophic repercussions on vultures. Poisoning is now the main driver of the African vulture crisis. I show that 20% of commercial farmers, and just 1.7% of communal farmers in Namibia use poisons to kill carnivores. Moreover, farmers that owned high numbers of small or large stock, and those who had suffered high livestock losses to predators, were most likely to admit to using poison. A map showing areas of high prevalence of reported poison use in Namibia is also derived. Furthermore, a generally positive perception of farmers towards vultures was apparent. In conclusion, the use of social science techniques, such as the one introduced here to investigate wildlife crime appears promising, and should be much more widely considered in the field of conservation.

Vulture Conservation Social Network Capacities and Challenges

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Responding to the African Vulture crisis will require coordinated efforts from multiple stakeholders, ranging from local communities and private individuals to government agencies and international organizations. However, uncertainties about currently participating stakeholders – who they are and what they do, how they work together, and their capacity to take action – exist. This information is vital for strengthening existing vulture conservation efforts and building capacity within the stakeholder network to address emerging issues. For this study, various community-level, government, and NGO stakeholders in Kenya and South Africa were interviewed about their activities promoting and supporting vulture conservation, current activity partners, and barriers and opportunities for protecting vulture populations. Study participants were also asked about resource need challenges and potential conservation partners. Social network analysis of conservation activity partner data maps out a loosely connected stakeholder network, dominated by a few individuals, where information and other resources may need

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** **William C. Andersen Memorial Award Candidate**

to travel through multiple intermediaries to reach the person or organization in need. Triangulation with interview texts supports this finding; revealing an institutional-level division of conservation activities that frequently relies on a single individual within an institution to accomplish vulture conservation tasks in addition to their other job responsibilities. While these individuals are strong advocates for Africa's vultures, they also represent a weak point, as their exit from the network due to unforeseen circumstances would have a significant impact on vulture conservation in the area where they work. Acquiring resources to accomplish current vulture conservation activities and identify emerging issues challenges stakeholders, yet these same challenges offer opportunities to establish new connections with potential partners and build network capacity.

Introducing Vulture Safe Zones to southern Africa

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BirdLife International successfully introduced the concept of Vulture Safe Zones in Asia. In India, the Bombay Natural History Society has reported stabilisation of the vulture populations in the designated Vulture Safe Zones of two states and an increase in the population of another zone in recent years. As the reasons for the decline in vultures in Africa are more varied than those responsible for the Asian vulture crisis, the application of Vulture Safe Zones should be adapted to reflect this complexity. The establishment of a Vulture Safe Zone requests the owners of large tracts of land to commit to managing their properties in ways that will provide safe havens for existing vulture populations. This focus on sound environmental practices could provide the landowner with reputational and economic benefits. Vulture Safe Zones have been implemented in Africa and could offer conservation solutions that are effective and achievable at grassroots level. BirdWatch Zambia is working to secure 4,000 hectares of the Chisamba Important Bird and Biodiversity Area for the benefit of vultures and the ecosystem. BirdLife South Africa has taken the first steps in southern Africa to secure Vulture Safe Zones. Through a strategic approach, we 1) defined this new concept in the South African context, 2) have undertaken a scientifically-based study to determine where Vulture Safe Zones would be best placed employing ecological niche modelling and a habitat remote sensing toolkit for breeding White-backed Vultures (*Gyps africanus*) across their distribution in South Africa based on the analyses of large sets of point

locality, tracking and nesting data and 3) enrolled this long-term project on one of South Africa's largest conservation properties, Tswalu Kalahari Private Game Reserve.

Quantifying the Levels of Lead Toxicosis in South Africa's Vulture Species

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Lead is a toxic heavy metal that serves no known biological function in any living organism. Its usefulness and malleability as a metal has made it pervasive in many aspects of human society and industry, despite the fact that its harmful effects on human and animal health have been well-documented. As obligate scavengers, Vultures are especially susceptible to dietary toxins, including lead poisoning. The insidious nature of lead poisoning could lead to a range of difficult-to-diagnose symptoms in birds, ranging in severity from mild to severe and even fatal. We conducted a nationwide assessment of the levels of lead toxicosis in South Africa's birds in general, and in Vultures in particular. Blood and bone lead samples indicate that a significant proportion of White-backed Vultures (*Gyps africanus*) and Cape Vultures (*G. coprotheres*) are displaying elevated lead levels. Non-vulture species, across all tissue types sampled, showed lead levels that are consistent with background exposure, suggesting that certain elements of Vulture ecology, such as their scavenging lifestyle, are making them particularly vulnerable to lead poisoning. Of particular concern were the high lead levels found amongst the unfledged chicks of a White-backed Vulture breeding colony near Kimberley. Since these chicks are not yet mobile, and display degrees of lead poisoning ranging from background to severe, we suggest that these chicks are not merely ingesting lead from diffuse sources such as dust from mining activities, but are also receiving metallic lead particles from carrion fed to them by their parents. Our findings point to fragmented lead ammunition as the probable source of the lead poisoning.

The Link Between Vultures and the Spread of Disease: A Review.

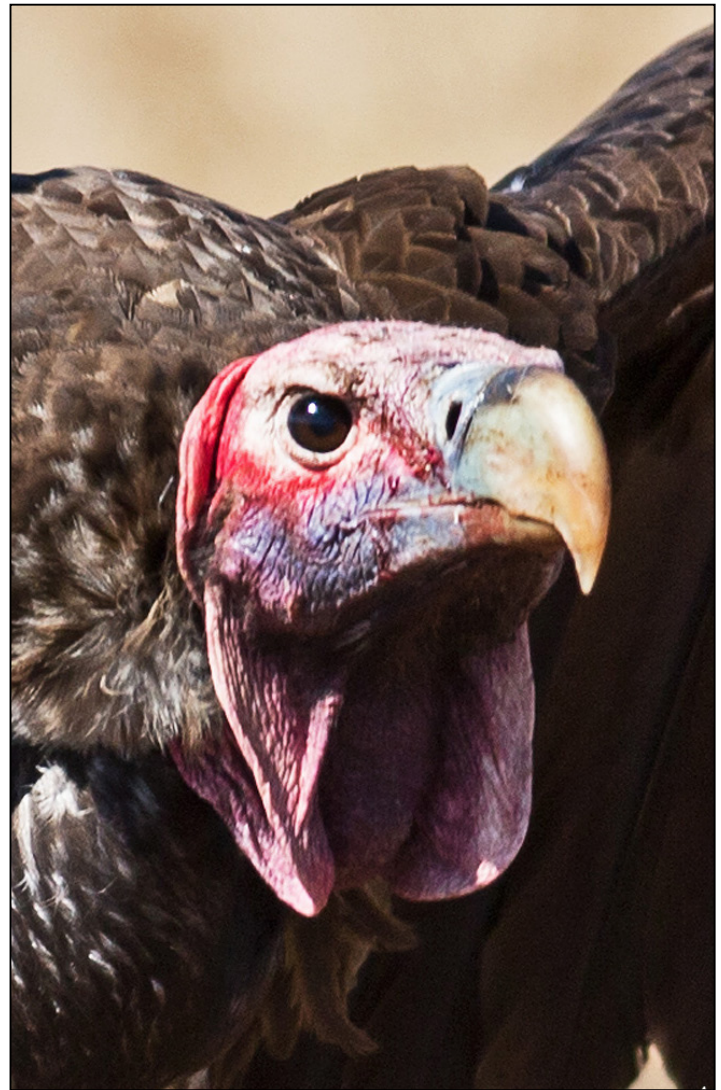
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The 'One Health' concept is a movement that is gaining momentum worldwide, and is cognizant of how the seamless interaction between veterinary and human medicine will benefit human health, animal health and the natural environment. We conducted a literature review to investigate the possible role vultures play in the prevention of disease. As obligate scavengers vultures have evolved a number of specialised adaptations to aid in the rapid detection and consumption of carcasses. In addition, vultures can greatly affect the composition of and interactions within a scavenger community. Research has shown that an absence of vultures could result in longer carcass decomposition times, an increase in the number of mammals present at carcasses, and an increase in the amount of time these mammals spend at carcasses. Interactions at carcasses between mammalian scavengers such as jackals, hyenas and feral dogs are frequently violent, and longer interaction times could facilitate the spread of diseases such as canine distemper and rabies, threatening the welfare of other mammalian carnivores and ultimately, human beings. Extended decomposition times could also potentially aid the sporulation and/or spread of bacterial diseases such as anthrax and brucellosis. Although research has attempted to show the economic value of vultures' carcass disposal services, and although the role of vultures in the prevention of disease seems intuitive, little research has been done to support this conclusion. We suggest that further research is urgently needed to quantify the exact role vultures play in the prevention and/or containment of diseases such as rabies and anthrax.



Lappet-faced Vulture | Photo by André Botha



Palm-nut Vulture | Photo by André Botha

SYMPOSIUM V ABSTRACTS

Falconry's Contribution to Raptor Research: Current Activities and Future Opportunities

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Falconry is an ancient relationship between humans and birds of prey that has been inscribed for safeguarding by UNESCO as an Intangible Cultural Heritage. Although operating across a huge diversity of cultures, falconry has a unifying requirement for an especially intimate relationship between humans, raptors, and the natural environment. Many falconry cultures remain traditional, while others are changing. Since its beginnings, thousands of years ago, falconers around the world have made significant contributions to our understanding of raptors and their conservation. This symposium aims to report on current research activities, and nurture the important future relationship between falconers and raptor research. Through a series of presentations given by falconers who are active in research and the International Association for Falconry and Conservation of Birds of Prey (IAF), we will: 1) report on the current state of falconry around the world, 2) describe on progress in a few of the many research and conservation projects that falconers are actively engaged within, and 3) explore and promote the future opportunities for engagement between falconry and raptor research.

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Falconry Meets Technology: Advancements in the Rehabilitation of Raptors in Western Australia

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It would be fair to say that most raptor rehabilitation, aviary based and otherwise, is not an exact science and remains difficult to measure in terms of success, or otherwise, without the use of expensive GPS transmitters. Data on post-release survival and mortality continues to rely heavily upon retrospective recovery of leg bands, microchips or other identifying marks (when they are used), or is largely anecdotal in nature. Without extensive free exercise flight in their own environment, physical fitness levels are difficult to accurately measure and evaluate, and there are no means of establishing whether any individual raptor, upon final release, is capable of hunting its natural quarry to levels equal to conspecifics surviving in the wild. Pre-fledging, and recently post-fledged orphans have limited opportunity to reliably develop their hunting skills. This presentation explores modern falconry techniques as a comprehensive method of rehabilitation and preparation for final release, in the few cases where it could be argued that it is essential if the particular raptor is to have any reasonable chance of survival, and in the case of others where it may also help them along the way. These methods include the use and analysis of live-stream real-time GPS data and the effectiveness of remote-controlled drones and flying wings as fitness tools during free-exercise flying rehabilitation, particularly in the case of the more dynamic hunter species such as Peregrine Falcons (*Falco peregrinus*).

Distribution and Ecology of the African Crowned Eagle (*Stephanoaetus coronatus*) in Zimbabwe

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The African Crowned Eagle is considered primarily a forest raptor with some populations existing in savanna/woodland biomes. In Zimbabwe, Crowned Eagles are found in riparian zones along major rivers and areas of rocky inselbergs, and despite falling within the savannah biome this distribution can support very high densities of the species. A total of 1495 prey remains of 37 different prey species were collected from 68 Crowned Eagle nest sites (incl. alternates) located in areas of riparian forest, exotic Eucalyptus plantation, Brachystegia dominated woodland,

Mopane (*Colophospermum mopane*) dominated woodland and Acacia savanna. While superficially Crowned Eagles are found in a variety of vegetation types, they occupy specific habitats within these landscapes and appear to remain loyal to primary forest habitat. Closed canopy evergreen riparian forest with large individual tree height is not far removed from tropical rain forest, however the unique weathering pattern and water drainage of granitic inselbergs supports specific vegetation and tree species that structurally also resemble riparian forest. This habitat is restricted to the rocky scree slopes formed by weathering of large inselbergs and is arranged concentrically around the base of these geological features. Daily movement of prey through riparian or riparian-like zones, either to access limited water supplies e.g. antelope and primates or to feed in the surrounds of otherwise poorly vegetated inselbergs e.g. Hyrax, conceivably provide opportunity for ambush predation by Crowned Eagles. Optimum habitat for Crowned Eagles in Zimbabwe is therefore offered by the intersection of perennial rivers with inselberg complexes.

The Use of Falconry Birds to Study Flight Behaviors and Energetics

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Raptors are notoriously difficult to study in flight because they are generally difficult to catch and handle. Falconry birds allow an easy access to otherwise challenging species. We studied flight behavior of Griffin Vultures (*Gyps fulvus*) and Himalayan Vultures (*Gyps himalayensis*) at the Rocher des Aigles falconry park (France), which is set at the top of a canyon, allowing birds to fly freely in natural conditions. By combining high precision GPS loggers, daily diaries (combining accelerometers, magnetometer and airspeed sensors) and electrocardiograms, we were able to describe Vulture soaring-gliding flight behavior in high resolution. We first studied what sensors best documented behavior in flight by comparing them to GPS track: while accelerometers are powerful at detecting every wingbeat, soaring flight in circles could only be detected using magnetometer. Overall Dynamic Body Acceleration was well correlated with heart rate in flight. While heart rate was minimal when vultures were perched and gliding at high altitude (c. 80 beats per minutes), the energy expenditure was maximal when the bird took off and landed (c. 300 bpm). We could confront our data with predictions from aerodynamical theory about bank angles in thermals and we

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** **William C. Andersen Memorial Award Candidate**

found that bank angle was much more variable than predicted, with birds adapting their bank angle with thermal diameter and altitude. Finally, using an experimental setup of releasing vultures in two groups (a group of leaders and a group of followers a few minutes after), we could investigate if individual decisions of following birds to find a thermal were related to the locations and soaring performance of leaders. In conclusion, falconry birds, if trained to fly under natural conditions, can be excellent models to study raptor flight behavior and energetics.

Raptor Conservation Through Captive Breeding and Falconry

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Falconers started breeding raptors only some decades ago. Some previous captive bred raptors were known, normally by zoos. We will revise the history of this success, including Peregrine Fund and others, but we will focus on some other projects which are not so widely known as the Orange-breasted Falcon (*Falco deiroleucus*), Bonelli's Eagle (*Aquila fasciata*), Lesser Kestrel (*Falco naumanni*), Spanish Imperial Eagle (*Aquila adalberti*), Javan Hawk-eagle (*Nisaetus bartelsi*), Andean Condor (*Vultur gryphus*), Isidor's Eagle (*Spizaetus isidori*), etc. We will discuss new techniques of raptor propagation, and will revise some figures about the quantity of raptors bred nowadays by aviculturist and falconers worldwide, discussing about possible impact in wild raptors.

A Holistic Approach to New Zealand Bird of Prey Conservation

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Celebrating 25 yrs, The Wingspan Bird of Prey Trust is New Zealand's premier bird of prey conservation organisation. Founded by falconers, it is one of the few centres embracing all aspects of bird of prey conservation, being actively involved in published field research, captive management and release, education, and was the driving force in legalising the sport of falconry in New Zealand in 2010. Wingspan trialed the first urban release of New Zealand Falcons (*Falco novaeseelandiae*) and worked closely with the forestry and viticulture business sector, looking for ways commercial and conservation interests can compliment one another. In 2004 the organization opened the Wingspan National Bird of Prey Centre, offering the public the opportunity for a close interactive experience, educational

flying displays, a small museum showcasing the biology, ecology and cultural history of birds of prey, and a specimen research repository to assist academia. This presentation discusses the role that Wingspan, and falconers have successfully played, and continue to play in a holistic approach to New Zealand falcon conservation.

The Past, Present and Future of Falconry's Contributions to Conservation

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Falconers have probably always been researchers. In training a raptor, the heritage that is tangible as equipment is quite small and the intangible large, but conceptual and technical innovation is important too. Resulting quantitative ecological observations, for example as nest survey, were written down a millennium ago. Raptor veterinary science flowered during the last millennium, and in the last century it was the turn of raptor ecology and then breeding behaviour, driven especially by discovery of impacts on raptors from trophic concentration of pollutants. Old techniques such as hacking have been joined by the development of systematic domestic breeding, radio-tagging (including GPS technology) and farming falcons in the wild. For there to be future contributions to conservation, falconry needs to be sustainable, ecologically and socio-economically. With the ecological aspect quite well understood, falconers have introduced approaches to categorising social acceptance and are now pioneering global (global-with-local) knowledge networking on the internet. Cultural understanding is being enhanced by research on falconry's history, and that too is important for social sustainability. As a falconry renaissance continues worldwide in the 21st century, one wonders what further innovations for raptor conservation falconers may develop with CRISPR technology, robotics and quantum computing.

Human-Eagle Partnerships through the Millennia: How Falconry Cultivates Ethno-Ornithological Knowledge, a Commitment to Conservation, and Respect for the Natural World

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The Altai Mountains and Tien Shan Mountains of Central Asia are the cradle of falconry. Pursuing Red Foxes (*Vulpes vulpes*)

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** **William C. Andersen Memorial Award Candidate**

with Golden Eagles (*Aquila chrysaetos*) first began here several thousand years ago, which arguably, was the first time man and raptor hunted in partnership. In modern times Kazakh and Kyrgyz herders carry on this falconry tradition and have a tremendous understanding of the wild lives of Eagles. They recognize the intricacies of Golden Eagles' reproductive biology and the migratory patterns of this population of Eagles as they move from Siberia through Mongolia and into China each autumn. An ethic of conservation is built into the practice: sub-adult Eagles are trapped, hunted for a time, then released in order for them to breed and carry on with their previous lives. When ranchers in the American west were faced with Eagle predation on young livestock, the answer was to shoot and poison them. But the Central Asian herder, who too cared for his livestock and occasionally witnessed a Golden Eagle kill a lamb, learned to partner with the Eagle. Falconry promotes this worldview. Additionally, Eagles pose challenges for conservation and rehabilitation. Eagles can bear the brunt of anthropogenic change to the environment (wind farm collisions, electrocutions, climate change) and populations can be slow to recover. As a long-lived, slow maturing and reproducing raptor, rehabilitation of Eagles is often a worthwhile endeavor. For a rehab Eagle to survive, it requires 1) hunting skill/experience 2) knowledge of soaring/thermaling) and 3) fitness. In the United States, falconers have pioneered a method to fly and hunt with rehab Golden Eagles in a two-year program to maximize survivability post release. In South Africa, falconers rehabilitate Crowned Eagles (*Stephanoaetus coronatus*), Martial Eagles (*Polemaetus bellicosus*) and African Hawk-Eagles (*Aquila spilogaster*) in a similar manner and with success.

Strategies for Managing Human Wildlife-Conflict, and the Rehabilitation of Injured and 'Problem' Crowned Eagles in Durban, South Africa

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Wildlife management is primarily a human response to reduce or eliminate causes of economic or social harm. However, these must be balanced against conservation goals regarding threatened species. The public stakeholders in an urban landscape have strong influences on the management of dangerous large animals such as mammalian carnivores.

Crowned Eagles (*Stephanoaetus coronatus*) occupy the Durban Metropolitan Green Space System in a suburban landscape, South Africa. Colour ringing and citizen science input allow us to identify occurrence of Eagle depredation on pets and livestock, with a bias demographically towards sub-adults, and seasonally in winter and spring months. Negative interactions due to pet depredation has resulted in some social conflict. Persecution using firearms is among the anthropogenic causes of mortality. Unintended mortality in the urban landscape includes electrocution, poisoning, and collisions with walls, windows, and wires. Collaborations between wildlife authorities, Non-Government Organizations and public stakeholder input creates an environment for successful management of human-wildlife conflicts with Crowned Eagles. Active management has helped to maintain public support and improved conservation outcomes for urban Crowned Eagles. Falconry-based fitness and hunting assessment is an integral part of tackling both the successful rehabilitation, and the public perception of active management. However there are many challenges to the successful completion and re-wilding of 'problem' and falconry-proven Crowned Eagles.

Understanding the Sensory Ecology of Raptors: An Essential Collaboration between Falconers and Researchers

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Collaboration between falconers and researchers may be essential for raptor conservation. A key point is to understand how raptors perceive their world. Being both a falconer and a young researcher, I studied, with collaborators, the visual and olfactory capabilities of different raptors' species using my own birds and others handled by different falconers. Especially, we estimated (1) the spatial resolution of both chromatic and achromatic channel, (2) the visual fields of raptors with different ecology and (3) the unexpected sense of smell of raptors for both foraging and communication. First, using operant conditioning experiments, we show that the achromatic spatial resolution is not superior to that of humans for all raptor species. Indeed, while some species have a visual acuity more than twice as high as humans, some have a visual acuity twice lower. However, the chromatic spatial resolution of Harris's Hawk (*Parabuteo unicinctus*) was the highest found to date in the animal kingdom. Second, using more than 15 species, we showed that the visual field of raptors is directly link to their

foraging strategies. Finally, using conditioning experiments, we showed that scavenger species can use their sense of smell to find food. Nevertheless, olfaction may not be only used for foraging. Indeed, using gas chromatography analyses, we explored the chemical composition of preen oil from Black Kites (*Milvus migrans*). We showed that preen oil encodes individuality, seasonal variation and chemical proximity. Our work may help to understand and reduce the rapid extinction of raptors. Indeed, increasing the knowledge of raptors' visual abilities may be essential to elucidate why they collide with human devices such as power lines and wind farms. Finally, showing that raptors have a functional sense of smell opens new ways to improve breeding in captivity and produce repellent odours associated with harmful chemicals such as dichlofenac.

Conservation Focused Satellite-tracking of Saker Falcons (*Falco cherrug*) in Russia and Mongolia

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In 2014, the Saker Falcon Task Force (STF) of the Convention on Migratory Species of Wild Animals' (CMS) Raptors MoU prepared and approved the Saker Falcon Global Action Plan (Saker GAP), which identified fields of action including 'flagship projects' to ensure the efficient conservation of that endangered species. Satellite-tracking of 100 individuals was one of the flagship projects to fill the knowledge gap identified by Saker GAP. Based on the proposal 27 individuals (adult = 7, juvenile = 20) were tagged in Tuva and Khakassia Republic, Russia and Mongolia in the period 2016-2018 with the support of Ecotone Telemetry Inc. and the International Association of Falconry and Conservation of Birds of Prey. The aim was to identify areas preferred by Saker Falcons and risk factors to focus later conservation activities. Results showed that juveniles roamed large distances after fledging and migrated south for winter. In breeding period, adults stayed in the eyrie (if breeding was successful) or commuted to larger distances (> 250 km) between the eyrie and temporary settlement areas (if breeding failed). Adults were mostly migratory and the Xinjiang, Qinghai and Tibet provinces in China are the main wintering areas. One individual tagged in the Mongolian Altai spent the winter in the

breeding area on about 2200 m a.s.l. Migratory adults returned to their previous breeding site and none of them showed nomadic behaviour. Trapping (n = 5) and electrocution (n = 1) were confirmed as major risk factors. Eight birds stopped transmitting for unknown reasons, while 13 Saker Falcons are still active. Background data showed a preference for forest-steppe, steppe, and semi-desert like habitats, as well as a strong link between breeding success and presence (abundance) of ground-dwelling rodents (mainly Pika and Ground Squirrel species).

Understanding and Re-establishing the Previously-extinct Tree-nesting Peregrine in Central Europe

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The Peregrine Falcon (*Falco peregrinus*) is known to breed on rocks or ground, and from the middle of 20th century began to colonize cities using skyscrapers. Tree-nesting occurs all over the world accidentally and does not form stable populations. Tree nests were found in Central and Eastern Europe, from northern-eastern Germany, eastern Denmark, Poland, southern Sweden and Finland, the Baltic States, Belarus, northern Ukraine and Russia up to the Ural, where Peregrine Falcons used nests of other birds. Even in the Polish mountains Peregrine Falcons nested in trees. In the 1950s, Peregrine Falcon populations decreased drastically or became extinct, including the tree-nesting European population. The last tree nest in Poland was found in 1964. A small relic population might exist near Ural. Understanding how the tree-nesting behavior occurred was a key to re-establishment of ecotype. Falconers in the German Falconers Orden (DFO) and in Poland began to breed and develop methods for reintroduction of Peregrine Falcons. In Germany there are ~60 pairs breeding in trees in the 2018 season. In Poland, reintroductions were conducted by the Society for Wild Animals Falcon, introduced 707 Peregrine Falcons. The first chicks from a tree nest were ringed in 2012, and eight tree nests were found in 2018. Chicks appeared to imprint on their place of birth, and imprinting has been successful with establishing growing populations in Germany and Poland. In Poland the satellite tracking project was started in 2010, and the DNA sample project is continuing. On the website of the Falcon Society since 2003 there are webcam transmissions from wild Peregrine Falcon nests, which are gaining increasing interest. The webcam in 2003 was probably the first one showing wild nature in Poland. In 2018 the first in the world tree-nesting Peregrine Falcon webcam was started.

SYMPOSIUM VI ABSTRACTS

Raptor Health and Contaminants

Co-chairs: Oliver Krone, krone@izw-berlin.de, John Elliot, john.elliott@canada.ca, Michael Jones, mpjones@utk.edu



This session will present papers on health and diseases including contaminants in birds of prey. The identification of threat to raptors is often accomplished by necropsies analyzing the causes of death. Mortality factors range from trauma, to diseases, intoxications, persecution, predation, adverse physical aspects. Monitoring pollutants is also crucial for the detection of population limiting effects as well as local poisoning hot-spots. Whereas wild birds of prey are monitored on population levels, birds used in falconry and raptors admitted to rehabilitation centers receive much attention with sophisticated diagnostic and treatment tools.

Emerging pesticide issues for raptors with a focus on American Kestrel

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Neonicotinoid insecticides were introduced in the early 1990s as compounds which rapidly replaced the highly neurotoxic organophosphates and carbamates that have resulted in direct toxicity to raptors and other vertebrates. This new group of insecticides were unique because they were both hydrophilic enough to translocate in plants and vertebrates for sucking-insect control but persistent enough to stay in the animal or plant for a year. Early studies indicated neonicotinoids had low toxicity to birds, however recent studies indicate their neurotoxic properties may affect migration orientation and ability to retain body mass. Furthermore, there is a dawning realization that insectivores may be affected by food loss due to insecticide use possibly combined with climate change that is drying areas earlier and for longer periods each year which can influence insect populations. American Kestrel (*Falco sparverius*) populations have declined 47% in North America and in this presentation we discuss how insecticide use, possible synergism with drying conditions, and other stressors throughout their range could contribute to declines.

3D Printed Lower Limb Prosthesis in Two Raptor Species: Harris's Hawk (*Parabuteo unicinctus*) and Little Owl (*Athene noctua*)

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A two-yr-old captive breeding male Harris's Hawk was referred to our clinic because of a severe left intertarsal joint region injury caused by another Harris's hawk. After cleaning the wound appeared to be in very bad condition. Tendons were exposed and soft tissues were loose. Surgery was performed in order to clean and encourage the wound to heal for the second intention. After seven days an amputation was needed because of necrotic soft tissue and loss of vitality of the foot. In order to avoid the possibility that the bird developed bumblefoot and to give a better life quality, we decided to try to make a leg prosthesis

with a 3D printer. The Little Owl was rescued after head trauma and with one leg stuck with a wire when he still had immature plumage. After intensive care, the outcome for the Little Owl was tarsal amputation and blindness in one eye. With the help of a General Electric computed tomography e-dual two layers scanner we reproduced 3D models (Ultimaker3) of the legs, based on the right healthy legs. We first realized a natural model with complete digits and talons, but this prosthesis sometime stuck with the other leg or with other object presents in the cage. We are now modifying the prosthesis to reach the perfect fit and maneuverability. The main issues to follow involve monitoring for the possibility of the development of pressure ulcers. In conclusion, this new techniques can be a valid alternative for the owner of pet raptors, and all avian pets in general.

Using Search Dogs to Reduce Raptor Poisoning in Hungary

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Widespread illegal poisoning was detected to cause the intoxication of 482 raptors and owls in Hungary between 2006 and 2013. Poisoning affected most seriously the local population of the globally threatened Eastern Imperial Eagle (*Aquila heliaca*), of which 68 specimens were found (8.50 detected specimens/year in average). To address illegal poisoning relevant stakeholders developed two complex conservation projects with the financial support of the European Union. In the frame of the HELICON LIFE project the first poison- and carcass searching dog unit in Central Europe was established with one German shepherd dog in 2013. Thanks to the successful operation of the unit, a Belgian shepherd dog could also be trained and joined the team in the frame of the PannonEagle LIFE project in 2017. In four yrs the unit carried out more than 800 field surveys and detected more than 260 carcasses related to wildlife crime cases. A remarkable result was that 78 poisoned baits were discovered during field work, which greatly facilitated effective police investigations. Most commonly perpetrators used pigeons or poultries as baits and carbofuran for poisoning, although terbufos and phorate were also detected occasionally. The unit also assisted in police search warrants and found illegal toxins, which were used for poisoning in three cases. The work of the dog unit greatly helped convict five perpetrators for crimes against birds of prey, which was unprecedented in Hungary. The projects contributed to the overall decrease of raptor poisoning incidents in Hungary, which was especially remarkable in the case of the Eastern Imperial Eagle, of which 11 poisoned specimens

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were found in the 4-yr period (2.75 detected specimens/year in average). In parallel to the decreased mortality, the Hungarian nesting population has increased by 36% in the same period and reached 205 pairs by 2017.

Exposure and Toxicity of Anticoagulant Rodenticides in Birds of Prey from Western Canada

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Anticoagulant rodenticides dominate pest rodent control globally. Second generation anticoagulants (SGARs) are persistent, bioaccumulative and toxic chemicals that have become widespread contaminants of terrestrial birds of prey. We present data on concentrations of anticoagulants and autopsy results for 560 raptorial birds found dead or brought into rehab during 1988 – 2016 in British Columbia. Larger generalist Owls, e.g. Barred Owl (*Strix varia*) and Great-horned Owl (*Bubo virginianus*), had the greatest incidence of exposure; smaller Owls e.g. Barn Owl (*Tyto alba*) had lower incidence, as did Hawks, e.g. Red-tailed Hawk (*Buteo jamaicensis*) and Cooper's Hawk (*Accipiter cooperi*). Bird eating Merlins (*Falco Columbarius*) had the lowest incidence of exposure among diurnal Raptors. Modeling of autopsy and liver residue data show Barn Owls to be the most sensitive to SGAR poisoning, while Great-horned Owls are the least. Probability of lethal AR poisoning increased above 0.1 ug/g SGAR in liver, and rapidly above 0.5 ug/g. Over the study period, the incidence of exposure to SGARs increased from 1988 onwards, remaining consistently high (above 75%) from 2003-2009, then declining from 2009-2016, which coincides with introduction of regulatory measures in Canada to reduce usage of the most toxic SGARs. Vehicle collision was the most common cause of death for all raptors, followed by trauma, undetermined cause, emaciation, and AR poisoning, which was more common than window collision.

Heat Stress in Falcons: Continuous Body Temperature Monitoring Throughout Heat Stress Challenges and Various Methods of Rapid Cooling

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Heat stress poses a significant challenge for captive-bred falcons in the U.A.E., particularly during early-season falconry training (September–October) because of high temperatures, overexertion, and lack of water intake. Severely heat stressed falcons often present as recumbent with labored, open-mouth breathing, occasionally accompanied by neurological signs. Pathological effects include rhabdomyolysis, electrolyte imbalance, and kidney failure. Normal body temperature of falcons observed at Al Aseefa Falcon Hospital typically ranges from 39-42 C°, however, maximum body temperature during a heat stress episode has not been described. Thus, our primary objective for this study was to characterize maximum core body temperature during clinical signs of heat stress and secondarily to test the efficacy of different methods for rapidly decreasing body temperature. We surgically implanted an iButton DS1923 thermo-logger in the left caudal thoracic air sac of a male Gyrfalcon (*Falco rusticolus*) for a period of two days. Body temperature was continuously recorded at 30-sec intervals, which included experimental periods of overexertion, cooling, and rest. The four methods of cooling included the administration of a) intravenous fluids, b) oral fluids, c) saturation of feathers with water, and d) placement in a chiller room (-17 C°). Maximum air sac temperature recorded by the iButton during a heat stress challenge was 44.6 C°, while mean temperature at rest was 41.3 C°. Minimum temperature recorded was 37.1 C°, which occurred two minutes after administering cold oral fluids (10 C°). We suggest the use of thermo-loggers in the caudal thoracic air sac as an effective method for collecting core temperature data of raptors. Expanded use in other raptor species may be used to predict heat tolerances and for modeling the effects of climate change on avian physiology. From a clinical perspective, our results indicate that heat stressed falcons may best be treated with simple administration of cold oral fluids.

Association between Hunting and Elevated Blood Lead Levels in the Critically Endangered African White-backed Vulture (*Gyps africanus*)

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Elevated lead (Pb) levels caused by the ingestion of spent hunting ammunition are of considerable concern to many species of scavenging birds across the globe, and in some cases are believed to be responsible for population declines. African vultures have shown alarming declines in recent decades; however, little research has been conducted on their potential exposure to Pb. Within many African countries recreational hunting represents an important economic activity, but carcasses and gut piles from hunting may provide an unsafe food source for vultures due to potential contamination with Pb from leftover ammunition fragments. It is therefore important to establish whether recreational hunting is associated with elevated Pb levels in African Vultures because this may be contributing to declines in these species. We explored this issue for the critically endangered White-backed Vulture in Botswana by examining their blood Pb levels (BLLs) both inside and outside of the hunting season, and inside and outside of private hunting areas. From 566 birds captured and tested, 30.2% of birds showed elevated BLLs (10 to <45 µg/dl) and 2.3% showed BLLs consistent with subclinical exposure (≥45 µg/dl). Higher BLLs were associated with samples taken inside of the hunting season and from within hunting areas. Additionally, there was a significant interaction between hunting season and hunting areas, with BLLs declining more steeply between hunting and non-hunting seasons within hunting areas than outside of them. Thus, all our results were consistent with the suggestion that elevated BLLs in this critically endangered African Vulture are associated with recreational hunting. Pb is known to be highly toxic to scavenging birds, including Vultures, and we recommend that lead ammunition in Botswana is phased out as soon as possible to help protect this rapidly declining group of birds.

The Avian Influenza Virus in the White-tailed Sea Eagle

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Since 2000 there have been several outbreaks of highly pathogenic avian influenza virus causing mortality in wild waterbirds. A major outbreak occurred in 2005 in western China, causing mortality of more than a thousand birds. Subsequently, H5N1 spread to Europe in 2005 and 2006, and caused mortality in a variety of wild birds. Since several raptor

species selectively hunt moribund or otherwise conspicuous prey, including waterbirds, or scavenge on their carcasses, they are assumed to be exposed to H5N1 during outbreaks of this virus. H5N1 infection was detected only in two species: Common Buzzard (*Buteo buteo*) and Peregrine Falcon (*Falco peregrinus*) in Germany in 2005/2006. Remarkably, the White-tailed Sea Eagles (*Haliaeetus albicilla*) that feed on waterbirds and carrion, tested negative. The reason why H5N1 was not detected in these eagle may be due to a species specific resistance. In a recent outbreak (winter 2016/2017), 17 H5N8-positive White-tailed Sea Eagles were found (three alive and 14 dead) among other birds of prey and waterbirds in Germany. Eagles found alive demonstrated mild to severe neurological symptoms including torticollis, opisthotonus, limber neck, ataxia and movement in circles. Most White-tailed Sea Eagles examined were juvenile or immature (13), one was subadult, and three adult. It is likely that the juvenile and immature white-tailed sea eagles found dead and infected were immunologically naïve to the virus. Older and, presumably immunologically “experienced”, eagles might have been cross protected by heterologous immunity derived from previous influenza A infections. Regarding the population integrity of the White-tailed Sea Eagles, the relevance of the HPAIV-related mortality remains unclear. Fatal infections of White-tailed Sea Eagles with H5N8 were recently reported around the Baltic Sea from Finland, Denmark, and Sweden. In January 2018 a juvenile White-tailed Sea Eagle was reported to be infected with H5N6 in Ireland.

The European Raptor Biomonitoring Facility, A European Network for Pollutants in Birds of Prey

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The European Raptor Biomonitoring Facility (ERBFacility) is a pan-European network consisting of 24 member countries seeking to reduce costs imposed by contaminants on human and wildlife health, by using raptors as sentinels for environmental contamination. ERBFacility aims to improve effectiveness evaluation, risk assessment, and early warning in relation to regulation of priority substances (REACH), plant protection products, biocides, veterinary products and heavy metals, with

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a focus on persistent, bioaccumulative and toxic compounds. ERBFacility is timely and relevant given the shift in chemicals regulation from national to EU level. ERBFacility has three objectives: 1) Assessing the current capacities and develop a framework for European raptor biomonitoring scheme, 2) Creating a framework for a distributed European Raptor Specimen Bank for contaminant monitoring, 3) Developing standards and protocols for a European Raptor Sampling Program. To archive the goals ERBFacility involves linked research, coordination, and capacity building in three arenas: A) For the analysis of selected pollutants ecotoxicologists, laboratories, and regulatory agencies working in this field will be connected and information exchanged. B) Information on collections such as natural history museums, environmental specimen banks and other collections will be compiled and a network established. C) For the field studies that gather samples, relevant contextual data methods will be analysed and harmonised. For more information see: http://www.cost.eu/COST_Actions/ca/CA16224 and the ERBFacility.

Blood Concentrations of Toxic Metals and Rare Earth Elements from E-waste in Nestling Eagle Owls

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Toxic metal accumulation and their adverse effects in vertebrates are well documented. However, rare earth elements (REE) and other minor elements (ME) increasingly used in technological and electronic devices have been rarely reported, with no studies in wildlife. This study reports for the first time blood concentrations of 50 elements, including essential trace elements (Fe, Zn, Cu, Se, Mn, Mo, Cr, Co, Ni), ATSDR's list toxic elements (Ag, Al, As, Ba, Be, Cd, Hg, Pb, Pd, Sb, Sn, Sr, Th, Tl, U, V), REE (Ce, Dy, Er, Eu,

Ga, Gd, Ho, In, La, Lu, Nb, Nd, Pr, Sm, Ta, Tb, Tm, Y, Yb) and ME (Au, Bi, Os, Pt, Ru, Ti) measured by ICP-MS in nestling Eagle Owls (*Bubo bubo*) inhabiting three different scenarios of contaminant exposure (agricultural/rural, n = 50; industrial, n = 14 and ancient mine site, n = 23; SE Spain). Some essential element concentrations (Zn, Se, Mn, Co, Ni) were higher in nestlings inhabiting the agricultural/rural area. Nestlings showed higher concentrations for some ATSDR's list toxic metal (As, Hg, Pb, Th, Tl), REE and ME (Ta, Os) in the ancient mine site. Hg and Pb are known to alter the metabolism and function of essential elements, which explains the negative correlations found (Hg-Fe, Hg-Mn, Hg-hematocrit and Pb-Co) in the mining area. A previous study showed that Pb, Cd and Hg at similar exposure level disrupted antioxidant molecules in this species. This study shows that, in addition to the classical toxic elements, Eagle Owls are exposed to other ATSDR's list elements, ME and REE, the latter included as new and emerging contaminants by international organizations. Toxic effects of long-term exposure to environmentally relevant levels of such substances are poorly documented and should be evaluated in future studies. This study was financed by Fundación Séneca (20031/SF/16 to S.E.).

Continental-Scale Patterns of Lead Exposure of Facultative Avian Scavengers

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Lead poisoning is documented worldwide in a variety of predatory bird populations. As facultative avian scavengers, Bald Eagles (*Haliaeetus leucocephalus*) and Golden Eagles (*Aquila chrysaetos*) are susceptible to lead exposure when they ingest lead contaminated gut piles and carcasses. To assess continental-scale patterns of lead exposure of North American Eagles, we analyzed samples of blood, femur and liver collected from both species throughout the United States. Mean blood lead concentrations were $17.45 \text{ ug/dL} \pm 47.44$ (\pm SD; wet weight) for Bald Eagles ($n = 113$) and $14.33 \text{ ug/dL} \pm 32.34$ for Golden Eagles ($n = 476$). Bald Eagles had higher blood lead levels than did Golden Eagles ($p = 0.04$). Mean femur lead concentrations were $7.88 \text{ ppm} \pm 24.67$ for Bald Eagles ($n = 189$) and $5.68 \text{ ppm} \pm 59.16$ for Golden Eagles ($n = 211$). Mean liver lead levels were $11.08 \text{ ppm} \pm 20.56$ for Bald Eagles ($n = 224$) and $7.51 \text{ ppm} \pm 61.56$ for Golden Eagles ($n = 197$). Bald Eagles had higher femur ($p < 0.001$) and liver ($p < 0.001$) lead concentrations than did Golden Eagles. Within species, we found regional, age-related and seasonal differences in Golden Eagle ($p < 0.001$, $p < 0.001$, $p < 0.001$) and Bald Eagle ($p < 0.001$, $p < 0.001$, $p < 0.001$) blood lead concentrations. We did not find regional or age-related differences in bone lead levels of Bald Eagles ($p = 0.466$, $p = 0.464$) or Golden Eagles ($p = 0.487$, $p = 0.486$). We found regional differences in liver lead levels of Golden Eagles ($p = 0.009$) but not in Bald Eagles ($p = 0.7$). Lastly, we found age-related differences in liver lead concentrations of Bald Eagles ($p = 0.009$) but not in Golden Eagles ($p = 0.4$). These exposure patterns within and between North American Eagle species provide further detail on lead poisoning in two facultative scavengers of conservation concern.



Brown Snake Eagle | Photo by Bill Clark



Hooded Vulture | Photo by André Botha

GENERAL ABSTRACTS



Cape Vulture | Photo by André Botha

Anthropological Impacts

Has the Threatened Grey Goshawk (*Accipiter novaehollandiae*) Adjusted its Breeding Ranges in Tasmania in Part due to Reduced Persecution?

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At European colonisation the Grey Goshawk was common in some Tasmanian regions. Locally intense persecution quickly established and remained (albeit covert) after legal protection. Consequently there were substantial parts of its potential breeding area largely unavailable for breeding. Effective gun control from the mid 1990s was coincident with a new threatened status bringing stronger legal protection. Increasing affluence meant less backyard chickens and pigeon keeping diminished. Thus, conflict (as complaints to authorities) was reduced and the rate of Grey Goshawks killed (as birds found shot or trapped) fell sharply to about a quarter of 1980s levels. Although there was considerable clearing of high quality breeding habitat in the northwest, such activity often introduced the European Rabbit (*Oryctolagus cuniculus*) and the European Blackbird (*Turdus merula*) and increased Tasmanian Native-hen (*Gallinula mortierii*) populations, all practical substitutes for natural forest prey. Thus, the Grey Goshawk breeding population remained high in such areas until the late 1990s when clearing became so intensive that many habitat remnants necessary for breeding were lost. Coincidentally, breeding commenced in many 'new' areas, places where immature Grey Goshawks had occasionally visited (but had usually been shot). These areas were in habitats traditionally regarded as sub-optimal for Grey Goshawks, the species often usurping Brown Goshawks (*A. fasciatus*) in the new status quo. Thus, from the late 1990s there appears to be a slight decline in breeding density of the former species in the northwest coincident with an increase in the northeast, central north and central south. In this new situation Grey Goshawks sometimes breed very close to people, something very different to before, and the species is a great favourite of bird watchers (as facebook postings). Redistribution does not appear to be a result of a general population increase (as road counts).

Building a Risk Map Tool for Verreaux's Eagle to Minimise Wind Turbine Collision Risk

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Concerns over the impacts of wind turbines on bird populations are increasing. Of particular concern is the negative impact that may occur for large raptor species. Raptors are long lived and reproduce slowly. Therefore, even apparently small increases in mortality rates can be problematic for their local populations. One way to minimise impacts of wind turbines on raptor populations is to place them in locations away from areas of high use. Predictive modelling has proven useful for other raptors for early identification of core use and high collision risk areas within planned development areas. The Verreaux's Eagle (*Aquila verreauxii*) is a large soaring raptor that is widespread in mountainous regions of sub-Saharan Africa. It has been highlighted as a species of conservation concern and one that is particularly susceptible to collisions with wind turbines. In this study, we are developing collision risk models using high-resolution GPS data obtained from 16 adult Verreaux's Eagles fitted with GPS tags from 2011 to 2017 in South Africa. We explore how territory holding eagles use the landscape, in particular how flight altitude and collision risk relate to the distance from nest sites and topographical features. We aim to create collision risk models which are generalizable across the distributional range of the species and importantly; these models will be incorporated within a novel user-friendly web based interface for use by the wind energy industry across Africa. This will allow developers to simply use the location of the species nest sites (which is collected as standard during pre-construction environmental impact assessments) to obtain a relative collision risk map of the proposed development area – thereby ensuring that wind turbines can be placed in locations that will minimise risk to flying eagles.

Does Landscape Type Influence American Kestrel Reproduction and Movements Along a Gradient of Urbanization in Northern Utah?

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Understanding how American Kestrels (*Falco sparverius*) respond to different human-modified landscapes could help explain documented declines of this formerly widespread North American species. Annually since 2014 we've utilized an army of 40-60 citizen scientists to monitor a network of 200-400 nest boxes distributed in different landscapes along the greater Salt Lake City metropolitan area, an area with a human population

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in excess of 1.2 million. We document clutch size, brood size, and number of fledglings produced by nesting Kestrels in wild land, agricultural, and urban landscapes. From 2014-2018 we monitored 421 Kestrel nesting attempts and found no difference in nest success (fledging ≥ 1) between nests in wild land, agricultural, and urban landscapes, although nest success in wild land landscapes appeared more stable than that of nests in agricultural or urban landscapes. Kestrels nesting in urban landscapes had slightly smaller clutches than their counterparts in agricultural or wild lands. We also band and colorband nestling and adult American Kestrels in an effort to monitor movement, and eventually estimate survival in different landscapes. To date we have banded 1,475 Kestrels in our study area, and color banded 634 of these birds and will summarize preliminary movements of resighted individuals.

Mind the Gap and Help Minimise the Threat Wind Energy Poses to Raptors

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In South Africa approximately one-third of bird carcasses found beneath wind turbines are raptors. Other threats currently present a greater risk, but increased investment in clean energy sources, including wind, alongside the expansion of electricity grid, is expected. BirdLife South Africa promotes the sustainable development of renewable energy by helping bridge the research-implementation gap. BirdLife South Africa and EWT's Best Practice Guidelines for Avian Monitoring and Impact Mitigation at Proposed Wind Energy Development Sites, and guidelines for assessing and mitigating impacts on priority species, have helped improve the rigor of impact assessment and standardise monitoring protocols, but there are some challenges. 1) The location of wind farms and the location of wind turbines, are the most effective ways to minimise impacts. However, literature to support the identification of areas of high- and low-risk is surprisingly scarce. 2) Predicting and assessing the significance of impacts are key aspects of environmental impact assessments and the subsequent evaluation of impacts. The need for mitigation is often closely tied to thresholds of significance (impacts may be positive or negative, and of low, medium, high, or very high significance), but data to support these assessments are often limited. 3) With time, the risk of cumulative negative impacts will increase and areas of good wind resource and low environmental risks will become rare. Novel mitigation strategies need to be tested

and data on the effectiveness of compensation measures will be required to support offset calculations. Through helping build strong evidence for management recommendations, the raptor research community can make a significant contribution towards helping wind energy develop sustainably - from relatively simple movement and population studies, to more complex risk models. Sometimes all that is required is to relook at existing data and present it in a way that it is useful and meaningful to decision-makers.

Raptors in Forest Plantations: Effects of Landscape and Territory Structure

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Habitat specialist species, such as forest raptors, are generally more likely to suffer from the impacts of silvicultural and forestry activities than generalist species. One of the most characteristic and controversial aspects of these productive systems is the use of clearcutting as a harvesting method, which generates a mosaic of highly contrasting landscape between wooded areas and practically devoid of vegetation. In this study, we analyzed how exotic plantations affects the abundance of raptors with different degrees of forest dependency, in landscapes dominated by exotic pine plantations in south-central Chile. Between 2016 and 2018, we used playback surveys to detect diurnal and nocturnal raptors in sampling points in 43 9 x 9 km landscapes (3–4 samples/landscape, 3–5 replicates each). We used recent satellite imagery and mapping information provided by timber companies to characterize the vegetation coverage present in each landscape. Our results show similar abundances between generalists and specialists species in landscapes with different proportion of forests and open (clearcut) areas. The Austral Pygmy Owl (*Glaucidium nana*) was the most abundant species detected (mean 0.53 individuals/point \pm 0.62 SE), followed by the Rufous-legged Owl (*Strix rufipes*, mean 0.44 \pm 0.55 SE). We found that the abundance of most species peaked at intermediate proportions of forest (native and or plantation) both at the landscape (9x9 km) and the territory (3 x 3 km) level. This finding suggests that both generalists (i.e. *Milvago chimango*) and forest specialists (i.e. *Accipiter chilensis*) are selecting areas with a mixture of forested and open land. Our results also show that generalists and forest specialists species can use the native forests and exotic plantations like a continuous habitat, which implies that exotic plantations landscapes with an

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appropriate management at different scales could have a certain value for raptors conservation.

Killing Threatened Birds with Green Energy: How Do We Make it Greener?

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More than 85% of South Africa's energy is supplied by greenhouse-emitting coal, oil and gas, despite South Africa being a signatory to the Kyoto and Paris Climate Agreements. To reduce this dependence South Africa has embarked on a program of green solar and wind power across the landscape. What are the costs to Africa's mega diversity? Birdlife's one yr review of avian fatalities at South African wind farms indicates 36% of all birds killed are raptors killed at rates as high as that in the USA. We investigated the reasons for this relatively high death rate at an Eastern Cape wind farm where five species of red data raptors occur and three species breed on site. In 42 mos 41 raptors of 13 species were killed, including some of the first records of migrant Amur Falcons (*Falco amurensis*) and Ospreys (*Pandion haliaetus*). Red data species observed killed or found under turbines included Martial Eagles (*Polaemus bellicosus*) (x two) and Black Harriers (*Circus maurus*) (x four). We found a seasonal increase in the "risky" flying heights of the harriers that are traditionally seen as low-level foragers. This increase coincided with a spate of turbine fatalities suggesting that flight height and risk of impact are related. Hidden costs were apparent following one Black Harrier and Martial Eagle death because the males killed were breeding birds supplying food to active nests - which failed. Since 22% of the turbines were responsible for the death of 68% of the raptors, this allows us to focus mitigation measures on the riskiest turbines. We have recommended that black-blade mitigation be enacted to experiment with this successful method to reduce mortality for all raptors attracted into the site.

Pilot Study to Evaluate the Effectiveness of DTBird® in Reducing Risk of Golden Eagles (*Aquila chrysaetos*) and Other Raptors Colliding with Operating Wind Turbines

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We conducted a 10 mo study to evaluate the effectiveness of DTBird®, an automated detection and deterrent system designed to minimize the risk of birds colliding with turbines. Our goal was to develop an initial quantification of DTBird's ability to detect and deter Golden Eagles and other medium/large raptors (e.g., *Buteo*) at an operational wind facility in southern California, where seven DTBird systems were strategically installed. A video detection module tracked objects based on settings calibrated for birds with wingspans similar to Golden Eagles, and a deterrence module emitted sounds to discourage birds from entering the rotor swept zone (RSZ) of equipped turbines. We used Eagle-like, fixed-wing unmanned aerial vehicles (UAVs), equipped with high temporal and spatial resolution GPS tracking devices, as surrogates to evaluate performance of the detection module in relation to a variety of landscape, flight characteristics, and visibility parameters. We evaluated the deterrence module by assessing the behavioral responses of in situ raptors exposed to the deterrent signals, as documented in DTBird video records. We estimated the probability of collision-risk reduction from deploying DTBird as the cross-product of the estimated probability of detection derived from the UAV flight trials and the estimated probability of deterrence derived from the in situ behavior studies. Our results demonstrated that deploying DTBird had the potential to reduce the risk of Golden Eagles entering the RSZ of study turbines by 33–53%. Several factors will influence the actual risk reduction at a given facility, however, such as the spacing and location of equipped turbines relative to Eagle/raptor activity, the relative abundance of resident versus transient birds, the prevalence of false-positive detections (i.e. detections of inanimate objects and non-target birds), and site-specific landscape conditions that influence DTBird's ability to reliably detect and track target birds (most notably variable cloud cover and sun glare).

Behavior

Post-fledging Movements of Urban Peregrine Falcons in Rome, Italy

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Peregrine Falcons (*Falco peregrinus*) are now occurring in many European cities where they breed on buildings and other elevated man-made structures. The reproductive biology and

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** **William C. Andersen Memorial Award Candidate**

parental behavior are easy to observe, due to webcams installed in their nests that are broadcasting real-time on the internet. However, movements of the young falcons in and around this urban habitat are poorly known. In 2017 and 2018 we tracked fledging peregrines from different broods in the city of Rome and we monitored their movements from their first flights around the nest until they become independent. The initial movements occurred about one month after the birds fledged (May) and were characterized by long-distance displacements. There were few hunting events during the first movements and birds returned to their nests to beg for food. The extent of daily movements decreased during the summer and by September most of the tracked birds settled in a restricted area within 250 km from their native zone and performed short daily flights. Females showed, in general, wider movements than males. The tracking also revealed some of the threats that young falcons must face to survive.

Intentional Fire-spreading Raptors in Australian Savannah Woodlands - Implications for International Research

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In this presentation I will discuss our research in northern Australian savannah woodlands on the fire-spreading behaviour of three species of Australian raptors. Prompted by a brief Aboriginal account published in 1964, since 2011 we have conducted extensive research into fire-spreading behaviour by these raptors. Our research examines connections between Northern Territory Aboriginal peoples' knowledge of this behaviour and contemporary ceremonial practices and the role of that knowledge in current land and fire management in the Northern Territory and elsewhere in Australia. We present Aboriginal and non-Aboriginal accounts of this behaviour and discuss questions about the effect of this behaviour on the evolution of savannah woodlands and possible international implications of our research.

Post-release Success and Dispersal of Rehabilitated African Fish-Eagles (*Haliaeetus vocifer*)

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The rehabilitation of injured wildlife is concluded with a successful release into the wild. Yet, it is important to determine if the release sites were suitable, and how far individuals move from where they have been released in order to promote survival. Together with Raptor Rescue, a specialist bird of prey rehabilitation facility, we tracked the post-release success of rehabilitated African Fish Eagles using GSM transmitters and alpha-numeric colour rings. To date four individuals have been released from hack enclosures with supplementary feeding. Surveys and discussions with land owners confirmed no resident African Fish Eagles were present at release sites. The longest survivor was an adult male whose transmitter failed after 185 ds. The remaining three have been confirmed as being killed by other African Fish Eagles. Two juvenile females were found dead near the release enclosures 54 and 51 ds post-release, and an adult female was driven into a swampy area eight ds after release and could not be recovered. The adult birds rapidly moved away from release enclosures, while the juvenile birds remained near them. A fifth release, an adult female, was directly back to her resident dam. She was found grounded for three consecutive days, despite being able to fly. It was deduced that she was being intimidated by a new resident Fish Eagle in the area and she was re-trapped until a more suitable release could be planned. There are currently two Fish Eagles due for release in October. These birds will be released at sub-optimal sites with supplementary feeding, where it is believed that intraspecific competition will be reduced. To date, results from this project have highlighted a significant challenge in releasing this territorial species and will potentially provide baseline criteria to increase the likelihood of post release success in the future.

Activity and Movement Rates of Nestling and Fledgling Bald Eagles (*Haliaeetus leucocephalus*)

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Development rates of young raptors are linked to parental investment and competition among siblings. However, little is known about the relationship between activity and movements rates and the length of the nestling and fledgling periods. To better understand activity rates and movement patterns of young eagles, we tracked 28 Bald Eagles from 15 nests in the Midwestern USA in 2016 and 2017. We used a custom designed duty cycle on a Cellular Tracking Technologies GSM/GPS telemetry

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** **William C. Andersen Memorial Award Candidate**

unit. This duty cycle recorded accelerometer activity and GPS data 5-7 sec intervals, while a bird was actively moving and at 15 min intervals at other times. Data were recorded from one h before sunrise to one h after sunset. We attached the units to nestling eagles that were 7–9 wks old. First, we tested the assumption that activity rate as recorded by the onboard accelerometer increased with age. We also tested the assumption that movement rate (km/d) of fledglings was related to age. Then to understand the relative influence of intrinsic and extrinsic parameters on activity and movement, we compared nestling activity rates and fledgling activity and movement rates (km/d) over time to sex, sibling rank, weather and nest location (upland vs. riparian). Finally, we summarized daytime hourly activity and movement rates to better understand when young eagles were the most active. Our results suggest that telemetry on young birds can provide important information about behavior during both the nestling and fledgling periods.

Dispersal Dynamics of Juvenile Secretarybirds (*Sagittarius serpentarius*) in South Africa

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The understanding of dispersal behaviour of juvenile Secretarybirds was previously limited to a small number of ring recoveries (n = 4) in South Africa. To gain a better understanding of the fine-scale dispersal movements of juvenile Secretarybirds, we fitted GSM-GPS solar trackers to individuals (n = 10) on their nests at the age of approximately eight weeks between 2012 and 2014. We were able to determine mean natal home range size using kernel density estimates, as well the average number of days spent in the natal territory during

the post-fledging dependency period. As birds aged, their exploratory movements around the nest expanded exponentially, with peak exploration activity during the mid-to-late morning. Juveniles showed high variability in maximum distance from the nest and timing of dispersal from their natal territories. Our study shows evidence for natal philopatry in this species and we were able to record the first age of breeding for a male Secretarybird. The wide-ranging nature of the dispersing juveniles exposes them to a diverse range of threats and a better understanding of their movements will help develop appropriate conservation strategies for this vulnerable terrestrial raptor that is showing population declines throughout Africa.

Breeding

Crowned Eagles of Mpumalanga, South Africa

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The aim of the Crowned Eagle (*Stephanoaetus coronatus*) project was to describe and monitor the Crowned Eagle population along the Drakensberg escarpment in Mpumalanga Province. The study has focused on the location and monitoring of Crowned Eagle nests. Being a forest specialist, the Crowned Eagles occur where there are fragments of indigenous temperate forest on the escarpment or dense woodland in mountainous granitic areas. Crowned Eagles' nest in large trees, usually along drainage lines. The spacing between the nests, in suitable habitat (10km), is relatively constant suggesting that the population could be saturated in suitable habitat. Most nests are repeatedly used. Over the past fifteen years, 59 Crowned Eagle nests have been located. Breeding takes place every alternate year unless there is some disruption. Chick and fledgling survival appears to be high. This paper presents the population data collected to-date, prey selection, discusses some of the reasons for nesting failures and opportunities for future research.

Helpers Increase Fledgling Body Condition In Bigger Broods In Cooperatively Breeding African Pygmy Falcon

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Diurnal raptors show high occurrence of cooperative breeding (14% vs. 3% of all birds). But, most records are anecdotal, likely due to the difficulty of data collection for this group of birds. The predominance of the trait may be linked to unique selection pressures, but these remain unexplored. We present a detailed study of the social breeding organization of the African Pygmy Falcon (*Polihierax semitorquatus*) in the southern Kalahari. We collected group size, group formation and breeding success data during six breeding seasons - from ca. 200 nests. We found cooperative breeding at 20% of nests, with multi-male (65%), multi-female (26%) and multi-male-female (9%) groups. Breeding groups included unrelated adults (44%), delayed offspring (35%) or both types of individuals (21%). Helper presence had no effect on laying dates, clutch size, nest success or fledgling production. However, helpers had a positive significant impact on the body condition of the chicks as brood size increased, acting as a buffer when breeding conditions are more demanding. Pygmy falcons are, therefore, facultative cooperative breeders that present a variable breeding group composition and occurrence within a single population, which makes them an excellent species to study cooperative breeding.

Supplemental Feeding of Golden Eagles (*Aquila chrysaetos*) to Increase Breeding Area Occupancy and Egg Production

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We established feeding stations at nine Golden Eagle breeding areas in northern Arizona, USA to test the hypothesis that providing food from early in the breeding season through the beginning of egg laying would increase breeding area occupancy and egg laying rates. We placed road-killed Mule Deer (*Odocoileus hemionus*), Elk (*Cervus canadensis*), and American Black Bear (*Ursus americanus*) at feeding stations located within 2 km of known nest sites from 5 December 2017 through 27 February 2018. Feeding stations were monitored using eight Megapixel trail cameras (cameras recorded one image at 30 sec intervals per detection). We replenished feeding stations and changed camera SD cards at night on a 5-9 d rotation, coupled with six hr Eagle observation periods conducted within breeding areas. A total of 4,325 kg of carcasses were deployed across

feeding stations (average 480 kg per station; range 143-826 kg) for an 84 d period, with carcasses available to Eagles for an average persistence of 75 ds per station (range 64-84 ds). We recorded 67,388 images of Golden Eagles at feeding stations. During supplemental feeding, all nine feeding stations were occupied by breeding pairs, and we were able to target and record feeding rates of females and males. Although there was no difference in egg laying rates during the supplemental feeding period (2 of 9 breeding areas produced eggs) compared to productivity data collected annually since 2011, rates of breeding area and nest occupancy (presence of greenery or fresh material in nests) were greater than in previous yrs. Continuation of this feeding study for additional breeding seasons will determine whether there is a lag effect to the treatment in increasing Eagle egg production and productivity in Golden Eagles.

Nesting Biology of the Bat Hawk in Western Madagascar

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The Bat Hawk (*Macheiramphus alcinus anderssoni*) is distributed from western to eastern central Africa, South Africa, and Madagascar. It is a poorly-known bird in Madagascar because it is a crepuscular and cryptic species. We studied nesting biology, habitat preference and food habits of the Bat Hawk in the Mandrozo Lake Protected Area (PA), western Madagascar from 2010-2017. We documented eight nesting attempts, and Bat Hawks laid a one-egg clutch, incubation was 48 ds by both male and female which occurred between February and April. Nestlings were inactive during the day and vocalized frequently at night from 2000-0300 H with wing flapping from 0400-0600 H (n = 517 observation hrs). Six young fledged successfully and dispersed from their natal nest area in September-October (n = 2 nests). Prey delivered by adults was composed of bats (59.4%), small birds (7.8%), and 32.8% unidentified prey (n = 64 prey items), and prey deliveries occurred from 1809-2328 H (n=43 night observations). The diet of Bat Hawks from pellets was made up of bats (73%) and birds (27%) (n = 401 prey items) and Vesper or Pipistrelle bat species (*Neoromicia/Pipistrellus*) (%MNI = 13.6) were the most numerous prey item recorded. The tree species (*Pterygota perrieri* (Malvaceae)) was used predominately for nesting (n = 5 nest trees). Pairs used the same nest consecutive years. Nests were located on the highest lateral branch and averaging 19.6m above the

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** **William C. Andersen Memorial Award Candidate**

ground, 23.5m tree height and 128.1cm DBH (n = 5). Human agricultural activities were the major threat to Bat Hawks. Seasonal surveys, environmental education, habitat restoration, and PA extensions are conservation solutions for conserving this species in Madagascar.

Population Dynamics, Status and ecology of Martial Eagles Breeding on Power Lines in the Central and Western Karoo, South Africa

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The Martial Eagle (*Polemaetus bellicosus*) is Africa's heaviest eagle species, occurring over a wide range of habitats at naturally low population densities. Throughout Africa, Martial Eagle populations are exhibiting concerning declines. South Africa is no exception; here recent research has revealed uniform reductions of up to 60% in populations over the past 20 yrs, including stronghold populations within protected areas such as the Kruger National Park. The locally Endangered South African population of Martial Eagle is currently estimated at fewer than 800 adult birds, with the bulk of the known population believed to be residing in our larger protected areas. Martial Eagles, however, also builds nest and breed on pylons that support high voltage transmission lines running through the largely treeless, semiarid landscapes of the Karoo. It is estimated that over a third of the national breeding population nests on pylon-structures in this region. This finding, which is at odds with the generally held belief that Martial Eagles are increasingly confined to large protected areas, has significant implications for our thinking around the conservation management of this globally threatened species. The long-term status and sustainability of the pylon-nesting population is currently unknown. While it certainly represents an important population, its relative size could well contribute to sustaining other marginal populations that would otherwise be declining. Alternatively, it may represent a sink population, whereby elevated mortality from electrocution or collision may be driving declines in the overall population. This project examines the status and population dynamics of Martial Eagles nesting on transmission structures in the central Karoo.

We monitor breeding using ground surveys and remote nest cameras, as well as the spatial ecology, dispersal, and survival of marked samples of adult and nestling Eagles using color-ringing and GPS-tracked individuals. Here we present our initial findings of research launched in July 2018.

Conservation

Accelerating the pace of conservation research: using advanced telemetry technology in California Condor research and management

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Despite adapting to dramatic changes in the landscape, the California Condor (*Gymnogyps californianus*) remains threatened by the presence of microtrash, lead, and other anthropogenic contaminants in their environment. In order to mitigate these potential dangers to condor survival, researchers and managers have outfitted free-flying birds with patagial radio and GPS telemetry units that allow for constant monitoring of their activity and location. Though these data are useful, it cannot verify condor behavior, which could indicate exposure to threats. Many condors wear transmitters equipped with accelerometers, which have recently been used in studies of other species to remotely detect behavior. This new data allows condor researchers and managers to explore in greater depth how condors survive in a human-dominated landscape and respond to conservation measures. Here, we use accelerometry and GPS data to extract and compare ground-based behaviors of 60 free-flying California Condors in human-dominated environments. To accomplish this, we first use ethograms and models from accelerometry data and video footage of captive condors to identify behaviors of wild birds. Then, we align ground-based behaviors of these birds with their GPS locations and use spatial datasets in a geographic information system (GIS) program to compare behaviors across different areas. Preliminary results suggest statistically significant differences in the frequency of ground-based behaviors across environments within the California population's range. More specifically, feeding and roosting occur more frequently on unmanaged land and in less urbanized areas. The completion of this project will influence California condor management practices,

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promote new techniques for evaluating human impacts to condor survival, and introduce new data analyses for advancing raptor conservation.

The Spatial Ecology and Roost Site Selection of Fledging Cape Vultures (*Gyps coprotheres*) in the Eastern Cape, South Africa

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The Cape Vulture, a species endemic to southern Africa, is listed on the IUCN Red List of Threatened species as “Endangered”. Juvenile Cape Vultures are known to forage extensively over a wider landscape and may face a greater assortment of threats. Understanding the movement and roosting behaviour of Cape Vultures may help identify areas of high use, which can aid management. The post-fledging movement of five Cape Vultures were recorded using GPS/GSM telemetry. Home range sizes, distance travelled from the nest and habitat use were determined over 11 mos during the post-fledging dependence period. Roost sites were identified through telemetry data, and environmental and physical conditions that influence roost site selection were investigated. Roost density in predetermined buffer sizes from the natal/breeding colony was examined. Juvenile Cape Vultures increased their home range progressively for the first two mos, then exhibited a rapid increase in size associated with dispersal from the colony. Distance from the nest increased rapidly following the dispersal period. Protected areas and woody vegetation were areas of preferred habitat use. Roost sites preference were those that were located close to colonies, had low accessibility to terrestrial predators, in areas of high wind speed and were often cliffs facing into the prevailing wind direction. The highest density of roost sites for juveniles was located within 20 km’s from the breeding colony and decreased further away. Roosting sites and foraging areas are important spatial determinants of Cape Vulture behaviour and the identification of such areas can help with conservation management. With the emerging and potential additional threat of wind farm development in areas highly utilized, wind farms located too close to colonies could have a devastating impact on the Cape Vulture population. Therefore, the importance of conservation buffer zones around colonies as no-go areas for wind energy development is paramount.

State of the World’s Raptors: Distributions, Threats, and Conservation Recommendations

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Raptors provide critical ecosystem services, yet there is currently no systematic, global synthesis of their conservation status or threats. We review the International Union for the Conservation of Nature’s Red List to examine the conservation status, distributions, threats, and conservation recommendations for all 557 raptor species. We further assess the significance of Important Bird and Biodiversity Areas (IBAs) for raptor conservation. We also determine which countries contain the most species listed under the Memorandum of Understanding on the Conservation of Migratory Birds of Prey in Africa and Eurasia (Raptors MoU). Raptors, especially Old World vultures, are more threatened than birds in general. Eighteen percent of raptors are threatened with extinction and 52% of raptors have declining global populations. South and Southeast Asia has the highest richness and the largest number of threatened raptor species. By country, Indonesia has the highest richness of raptor species (119) and most declining species (63). China and Russia contain the most Raptors MoU species, although they are not yet signatories to the agreement. Raptor species that require forest are more likely to be threatened and declining than those that do not. Agriculture and logging are the most frequently identified threats, although poisoning is especially detrimental to Old World vultures. Of the 10 most important IBAs for raptors, six are in Nepal. Highest priority conservation actions include preventing mortality and conserving key sites and priority habitats. Improved long-term monitoring is also needed for conservation to be appropriately targeted and effectiveness of interventions to be

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assessed.

Raptors of a Pristine Rain-forest: A Case Study of Ayikunugba Waterfalls Oke Ila Orangun, Osun State, Nigeria

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A recent survey to estimate the population of raptors in a pristine rainforest environment of Ayikunugba Waterfalls Oke Ila Orangun revealed that the heavily forested rainforest which housed the untapped waterfall holds a number of raptor species that is also found in other forest in West Africa. In total, 746 raptors of 21 species and four families were recorded in the forest habitats of the waterfall. Accipitridae family had the highest species sighted with 16 species followed by Falconidae having 3 species while Tytonidae and Strigidae have one each. The number of raptors in the unprotected area during the rainy season was lower than in the dry season with 421 birds sighted in the dry season while 325 was sighted in the wet season, with Yellow-billed Kite (*Milvus aegyptius*) had the highest rank during the dry season while the Common Kestrel (*Falco tinnunculus*) topped the rank during the wet season. The mean abundance of raptors was higher in the dry season with 52.63 ± 1.36 while its lower in the wet season with 40.63 ± 1.92 and this was significantly different between the two seasons ($F=39.19, p<0.001$).

Wetland Habitat Conservation from a Species Study: Lesson Learned from Madagascar Fish Eagles

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The Madagascar Fish Eagle (*Haliaeetus vociferoides*), a critically endangered raptor endemic to Madagascar, has been studied since 1992 at Manambolomaty Lakes Complex (MLC). Since 2001, Fish Eagle nesting surveys and monitoring have occurred

three times a yr during the egg laying, nestling and post-fledging periods for 11 territorial pairs. A model of wetland resource management was installed with local community associations, composed of fishermen who utilize the fisheries, and The Peregrine Fund to protect the wetland habitat and resources for Fish Eagles and other biodiversity. Management actions taken were limiting fishermen to 400 at five fisherman camps, the distance of this species' nest to a fisherman camp is a minimum of 500m, and important fisheries core areas are delimited and restricted inside the lakes. In 1999, MCL became one of the first two Ramsar sites in Madagascar, and it received definitive status as the Tsimembo-Manambolomaty Protected Area (PA) in 2015 that included dry forest and mangrove habitats. A mitigation program has been developed to decrease the impact of natural resources used by local communities at this site and one of the activities benefitting Fish Eagles, which use large mature trees for nesting, was providing 92 fiberglass canoes for the fishermen to decrease the use of large trees for dugout canoes. Following the experiences obtained by the wetland resource management at MCL this was duplicated to another wetland site at Mandrozo Lake PA, the second protected area managed by The Peregrine Fund. In 2015, this model of wetland resource management and conservation was elucidated to four other protected areas along the western coast of Madagascar that contained 32 territorial pairs of Fish Eagles. The protected areas managers at these sites placed the Madagascar Fish Eagle as an important target species of their management plans.

Population Monitoring and Dynamics of the Peregrine Falcon in Northern Ireland

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Population dynamics of the Peregrine Falcon (*Falco peregrinus*) are widely studied globally. This study reviews historical information and describes field survey data collected over a forty yr period (1977-2017) from Northern Ireland. Peregrine Falcon breeding parameter data are collected by volunteer raptor field workers and a network of skilled volunteers exists which now surveys more than 200 potential breeding sites annually in recent yrs. The population has expanded from approximately 50 occupied territories to 100 territories, but has declined since the mid 1990's to around 80 territories. Between 1977 and 2017 the maximum number of pairs recorded in a single yr was 92 in

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** **William C. Andersen Memorial Award Candidate**

1991. Mean breeding success is around 70% of pair occupied territories and a range of 113 (range 61-156) young are fledged per annum. The peak number of young fledged in 1992 when 156 young fledged and recent monitoring in 2014 when 154 young were confirmed to fledge. There is good knowledge on the dynamics of the Peregrine Falcon population in Northern Ireland, but the population may be constrained by illegal killing and persecution (typically via illegal poisoning). Some pro-active crime prevention and detection projects have been implemented locally including the use of drones for monitoring in collaboration with the police. Whilst there have been some specific ringing (banding) studies and diet composition analysis undertaken, the study requires further research on prey availability, population demographics and a strategic analysis of the long-term study data is now underway.

Conservation Status of Taita Falcon: What We Know, What We Need to Know, and What We Probably Will Never Know

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The Taita Falcon (*Falco fasciinucha*) is a small bird-eating, cliff-nesting falcon. It is thought to be one of the rarest falcons in the world, and one of the rarest raptors in Africa. While this perception may accurately reflect the species' conservation status, it may also have been overlooked in many areas of un-surveyed, inaccessible terrain. The South African Taita Falcon Survey Team (SATFT), BirdLife South Africa Species Guardians, has been surveying areas of southern Africa for breeding pairs of Taita Falcon, and monitoring a small population of known pairs, for over a decade. This work has had two primary aims: (i) to build a long-term dataset of territory occupancy and breeding success for up to 11 known territories in the Mpumalanga/ Limpopo escarpment region of South Africa, and (ii) to conduct new surveys of previously known hot-spots for the species. Our monitored population generally exhibits variable territory occupancy, low numbers of breeding pairs annually, and low fecundity - life history traits unlikely to sustain long-term stability. Two recent surveys of a section of the Batoka Gorge on the Zambezi River – an area that supported at least six pairs of Taita Falcon in the early 1990s – found no Taita Falcons at this site, partly confirming suspicions that 'core' concentrations of

the species are disappearing. We present preliminary findings of a model-based assessment of habitat use and community structure in South African Taita Falcons that examines the extent to which populations are constrained by resource availability and competition from congeners. We also propose a program of future research including systematic searches for new breeding populations of Taita Falcon in promising areas not searched before, and an intensive study of the natural history of the South African population focusing on diet, provisioning rates at nests and competitive interactions with other cliff-nesting raptors.

Foraging and Diet

The State of Vulture Supplementary Feeding Stations in Southern Africa

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We are currently experiencing an African vulture crisis, with seven of the continent's 11 vulture species being at risk of extinction in the near future. For decades, there has been a strong emphasis on one specific conservation strategy; namely that of supplementary feeding stations (SFS), also referred to as vulture restaurants. Self-motivated members of the public run the majority of SFS in South Africa. By supplying vultures with a reliable and safe food source, SFS are proposed to reduce poisoning risk (the major cause of mortalities) and increase breeding success and survival. There is, however, controversy surrounding the net effect of SFS. Evidence of the mentioned benefits is in many cases contradictory and there are concerns about dependence on these stations and the long-term health effects of a potentially contaminated artificial food source. SFS's conservation value is likely dependent on how they are managed. Despite the potential negative effects, many conservationists are currently advocating for the use of SFS by landowners and their popularity as a waste disposal method has increased over the last few decades. It is therefore imperative that their conservation value be clearly unpacked and demonstrated. To do this, accurate information on the state of SFS is required. We

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** **William C. Andersen Memorial Award Candidate**

conducted a survey with all recorded SFS managers/owners in southern Africa to verify and update the SFS database records. Furthermore, we explored the socio-economic and managerial context in which SFS are operated; such as the motives for their establishment and the awareness of SFS managers of vulture conservation issues. These results highlight the need for increased communication between conservation officials and privately managed SFS, in order to minimise any detrimental effects to vultures and thereby maximise their conservation value.

Repeatability of Foraging Areas in an Immature Cape Vulture (*Gyps coprotheres*): Identifying Priority Conservation Areas

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We monitored a juvenile Cape Griffon Vulture by satellite tracking from January 2014 to 31 December 2017. By the time of the last location the vulture was still alive. Overall, and referred to political boundaries, the vulture visited seven countries: South Africa, Namibia, Angola, Zambia, Botswana, Zimbabwe and Mozambique involving nearly 2,000,000 km². Since its departure and return in late 2017 there were three core areas (50% use KDE) in the Namib Desert, the Okavango Delta and Kruger NP with an extension into the Magaliesberg Mountains. The use of the core areas also changed between years with both the Namib and Okavango Delta being used in all years, KNP only used in 2016 and southern Zimbabwe in 2016 – 2017 and the core Cape Vulture breeding area of Blouberg, Moletje, and the Magaliesberg colonies in 2017. However, the vulture never crossed to the south joining other vulture sub-populations in the Eastern Cape. In addition, there were other regions it never visited, such as the Waterberg or central Botswana (Kalagadi and Central Kalahari). Shifts between core areas involved flights within a single or a couple of days. Daily activity measured as distance covered between consecutive locations ranged from 0900 to 1700 with a peak in the midday. This pattern was similar over the three yrs. Considering the high use areas, the Cape Griffon Vulture would concentrate in regions of high wild ungulates density. All extended over hundreds of km², so it is a challenge for vulture conservation to protect them from threats such as poisoning. Cooperation of NGOs is not enough without Government involvement at both country and international level.

Martial Eagle Diet in Kenya's Maasai Mara region
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Detailed knowledge of dietary requirements and preferences for apex predators can help develop effective conservation strategies. Studies on the diets of some of Africa's threatened raptors are lacking and there is an urgent need to fill this knowledge gap. We investigated the diet of 19 adult Martial Eagles (*Poleomateus bellicosus*) in the Maasai Mara region of Kenya to document the species' diet and assess dietary differences between the sexes. Dynamically collected Global Positioning System (GPS) transmitter data from these 19 study birds were used to rapidly identify kill locations that we then visited to identify prey remains. Over a 19 mo period, we visited 206 kill locations and successfully identified the remains of 191 Martial Eagle kills. Our study found that Martial Eagle diet comprised 26 prey species of which Hares (*Lepus sp.*) (17.3%), Impala fawns (*Aepyceros melampus*) (13.6%), and Helmeted Guineafowl (*Numida meleagris*) (12%) were the most numerous. To assess dietary differences between the sexes we categorized prey species in four body mass classes (S = Small (0-999 g), M = Medium (1000-2999 g), and L = Large = (3000-4999 g). We found that male diet differed from female diet based on these assigned body mass classes, with females selecting for larger prey items (coefficient = -2.64, Z = -5.96, P < 0.001). This intraspecific dietary difference correlates with observed weight differences between male and female Martial Eagles in the Maasai Mara and provides supporting evidence for the food niche hypothesis as the evolutionary driver of reversed sexual dimorphism in raptors. These findings are the most comprehensive dietary analysis of the Martial Eagle in East Africa, and the first study to show significant dietary differences between the sexes for this species.

Quantifying Prey Delivery Rate of Barn Owls and Influence of Habitat Composition in Napa Valley Vineyards

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Globally, farmers have managed their land to provide habitat that supports natural enemies of agricultural pests. Wine grape farmers in Napa Valley, California have installed nest boxes to

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** **William C. Andersen Memorial Award Candidate**

attract Barn Owls (*Tyto alba*) to manage economically damaging rodents, but the magnitude of the ecosystem service of rodent pest control delivered by Barn Owls is unknown. Further, Barn Owl diet has been assessed in various ecosystems, but a rigorous analysis of prey removal in a vineyard system has yet to be performed. We used nest box cameras to document prey delivery rates of nesting Barn Owls to provide an index of rodent removal and prey species composition. Preliminary data suggests that a single chick received 183 prey deliveries from the time of hatch until dispersal, consisting primarily of Voles (*Microtus spp.*) and Botta's Pocket Gophers (*Thomomys bottae*). Prey delivery rate peaked between wks four and five with a peak average of 4.09 prey deliveries per chick per night and overall average of 2.86 prey deliveries per chick per night. Data also suggests that various levels of landscape heterogeneity may contribute to variation in prey delivery rate. Elucidating these trends will help with the strategic placement of nest boxes in vineyards and incentivize farmers to conserve habitat important for nesting Barn Owls and other local wildlife.

Diet of American Kestrels (*Falco sparverius*) in mixed Oak Woodland in Northern California

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The range of the American Kestrel in North America extends from the tree line of Alaska to the southern tip of Florida, encompassing two separate subspecies and a wide variety of habitats. Recent demographic analyses of American Kestrels have identified a potential decline in the estimated population size using data from counts at nest box programs, banding sites, and hawk watches in different areas of North America. Understanding how Kestrels are utilizing different habitat types may add important information to help explain what may be driving these fluctuations in numbers. In this study, we used cameras to record the actions of male and female adults at nest boxes in northern California. Boxes were situated in mixed Oak (*Quercus spp.*) Woodland habitat on active range land in ecological reserves. Motion activated cameras were placed facing up to document when Kestrels entered and left nest boxes, the sex that was present at each box, and what and how often different prey types were delivered to the nest. Focusing on the period after the eggs hatched to fledging, an average of 333 hrs of observations were recorded per camera ($n = 10$). Prey items included arthropods, reptiles, mammals, birds, and an amphibian. Differences in the types of prey delivered by each

pair of Kestrels, the frequency of delivery, and box location were examined, in addition to how the types and frequency of prey delivery may have related to the number of eggs and fledglings at each box, and the plumage characteristics of the fathers. Different pairs of American Kestrels appeared to specialize in different types of prey for delivery to their boxes, and a greater occurrence and diversity of reptiles were found to be present in diets than was anticipated given previous studies in other habitats in North America.

Genetics and Plumage

Application of Morpic-Google Images Web Tool for Raptor Studies

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Information on the spatial distribution of phenotypic traits can be important for evolutionary and ecological studies. However, traditional approaches, such as fieldwork, can be time-consuming and expensive. Information technologies, such as Internet search engines, could facilitate the collection of these data. We investigated the use of Google Images to extract data on geographical variation in phenotypic traits visible from photographs. We compared the distribution of visual traits obtained from Google Images with four previous studies. We found very good agreement between fieldwork data and Google Images data across all studies. Our results suggest that this method can work well for visible traits of common and widespread species and may have many other uses. To facilitate the data capture of this method we developed a free-to-use web application (Morphic). Using the Morpic web app we use this approach to extract spatial data in a range of novel systems and present the findings from two of these studies. Firstly, we use this approach to explore the suspected clinal variation in the morph distribution of Swainson's Hawks (*Buteo swainsoni*) across their North American breeding distribution, and whether these

* **Presenting Author**

** **William C. Andersen Memorial Award Candidate**

patterns are correlated with environmental variables. Secondly, we investigate the diet across Africa of the declining Martial Eagle (*Polemaetus bellicosus*), comparing prey items among regions and between adult and sub-adults. The Google Images method is cost-effective and rapid and can be used with some confidence when investigating patterns of geographical variation, as well as a range of other applications. In many cases, it could, therefore, supplement or replace fieldwork.

Characterizing Genomic Distinctness of Haida Gwaii Goshawks in British Columbia

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In the current era of anthropogenic change, many species of raptors are of conservation concern. In Canada's western province of British Columbia (BC), Northern Goshawks (*Accipiter gentilis*) face decline. Complicating matters further, a BC endemic subspecies of Northern Goshawk (*A. g. laingi*) is also in decline; however, its genetic distinctness and range are not well known. The range of *A. g. laingi* was first described by P.A. Taverner as encompassing the archipelago of Haida Gwaii off the coast of BC. Currently, the range of *A. g. laingi* is described as including the coast of BC, Vancouver Island, Haida Gwaii, and the Olympic Peninsula, but the designation of this range is contentious. Using GBS (genotyping-by-sequencing), to survey genetic variation at thousands of loci across the genome, we assess the genetic distinctness of the *A. g. laingi* subspecies relative to the other North American subspecies (*A. g. atricapillus*). Following this, we used genotyping assays developed from our sequencing data to genotype hundreds of additional samples to clarify the range of the *A. g. laingi* subspecies. We find that the *A. g. laingi* subspecies is genetically distinct from *A. g. atricapillus* and seems to be restricted to the Haida Gwaii archipelago. These results encourage increased conservation efforts directed toward this small and declining Haida Gwaii population.

Extreme Variation in the Tails of Harlan's Hawks

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Harlan's Hawk (*Harlan's Buzzard*) (*Buteo (jamaicensis) harlani*) adults show extreme variation in the color and pattern of their

upper tails. All other raptors show little or no variation in their adult tails. I have examined more than 1000 museum specimens, more than 30 in-hand buzzards, and more than 100s of photos of this taxon and found that their adult tails vary greatly in color and markings, with no two tails appearing exactly alike. These tails can be sorted into five categories: gray, gray banded, rufous, rufous banded, and mixed. I will present a sample of each group, showing the range of variation of markings within each group and present the relative frequency of each, based on more than 600 photos of adult tails. Dark tail markings include mottling, grizzling, streaks, and banding. Subterminal bands vary from absent to wide and irregular. Further, some adult Harlan's tails can show differences in color and pattern among tail feathers and even on single feathers. The tails of juveniles also are quite variable, as I will briefly show. Finally, I will relate a few examples of adult tails that varied somewhat in color and pattern in different years. Future advanced genetic techniques should be able to identify the genes that are causing this extreme variation, not shown to my knowledge, by any other raptor, nor for that matter, any other bird.

Whole Genome Sequencing Reveals Subspecies Taxonomic Affinities for Peregrine Falcon

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The Peregrine Falcon (*Falco peregrinus*) is a widespread species occupying every continent except Antarctica. A total of 19 Peregrine Falcon subspecies are currently recognized. However, previous molecular phylogenetic analyses, based on mitochondrial (mtDNA) control region sequence data, have

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** **William C. Andersen Memorial Award Candidate**

shown little support for current subspecies classifications. Given the species' capacity for long distance dispersal, gene flow may exist between subspecies preventing differentiation. Alternatively, insufficient variability may exist with mtDNA to assess levels of differentiation among subspecies limiting our ability to quantify levels of isolation. To what degree similar patterns exist with nuclear sequence data remains to be explored. Here, we use a genomic approach to generate whole genome sequence datasets among 18 of 19 Peregrine Falcon subspecies to identify whether increased nuclear DNA sequence data compared to mtDNA can resolve subspecies taxonomic affinities. Based on preliminary results from 8 of the 18 sampled subspecies (primarily Pacific), a lack of congruence between subspecies taxonomy and phylogeny was observed using whole mtDNA genomic sequence data (~17,000 bp). In contrast, however, low coverage (~1x) nuclear genome sequence dataset (~7 Mbp) provided support in congruence with taxonomy for multiple sampled subspecies. The Holarctic subspecies *F. p. pealei*, *F. p. furuitii*, and *F. p. pelegrinoides*, including *F. p. cassini* in Chile and Falkland Islands, and *F. p. madens* in Cape Verde each form monophyletic clades separate from the oceanic subspecies, *F. p. macropus*, *F. p. nesiotes*, and *F. p. ernesti*, which were paraphyletic. Current analyses are underway to include the majority of remaining subspecies and higher sequencing coverage (~10x) of the nuclear genome. A more thorough genomic analysis of Peregrine Falcon subspecies not only would allow an accurate estimate of the timing of divergence, but also offers a potentially powerful dataset to associate genotypes with specific traits given their divergent morphologies despite low genomic divergence.

State Uncertainty: Sex Effects and Correlates of Recruitment

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For many species of raptors sex cannot be assigned by plumage. While dimorphism between sexes is quite common in birds of prey, some morphometric overlap still exists causing uncertainty in sex determination, especially for nestlings. Such overlap maybe confounded by individual hatch order and physical stunting when nutritional resources are limiting. Additional factors such as genetics, natal rearing conditions, adult investment, and inter-brood dynamics are also expected to contribute to nestling development and thus influence the certainty of sex assignment. We used a state-uncertainty model in Program

Mark to examine sex effects on recruitment and incorporate morphometric, territory, and parental components as covariates. Predictive covariates included structural size, brood size, hatch date, territory occupancy history, and parental quality (i.e. age, pair longevity, lifetime reproductive success). Individuals were assigned to an initial unknown state and then transition to a male or female state upon recruitment into the breeding population. We account for developmental stunting using a metric that assigns values based on differences in feather development between siblings, as we expect to observe variability in nestling development based on differences in habitats and parental investment. While genetic tools easily allow for sex determination, this may not be economically feasible for long-term projects. Here we use banding data from nestlings spanning 2008 – 2018 incorporating over 1,000 individuals. A greater understanding of sex effects on recruitment is vital for understanding the population dynamics of younger age classes.

Habitat

Habitat Use and the Drivers Behind Population Declines in the Pel's Fishing Owl (*Scotopelia peli*)

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The Pel's Fishing Owl is a poorly studied afro-tropical bird species, yet has the potential to be an exceptional indicator of eco-system health along river systems within their range. Due to their secretive habits and tendency for residing in dense and hard to access areas, there is still a large knowledge gap surrounding most aspects of this species' ecology, as well as their response to a range of environmental and anthropogenic factors. We investigate the spatial ecology of the species through the use of modern light-weight telemetry devices to follow the movements of up to eight individuals to better understand their response to changes within their known territories, as well as creating an improved concept of the habitat requirements and main aspects that affect their distribution within the study area and further throughout their range. Furthermore to this, we will also instigate the implementation of a range of monitoring tools and metrics to further investigate the relationship between key avian indicator species and riparian ecosystems. This will be done by scrutinizing three major aspects, namely, changes in water

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quality through automated monitoring stations, analyzing remote sensing data to look at vegetation change and health, and lastly the use of bio-acoustic recorders to monitor ecosystem health and the presence and abundance of key avian indicator species. Our initial findings have already resulted in an increase in the known population size within the study area, whilst revealing some variations between the ecology of individuals along separate rivers displaying significant structural differentiation in the riparian habitat.

Effects of Wine Country Wildfires on Barn Owl Habitat Selection in Napa Valley

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In the world-renowned wine growing region of Napa Valley, California, wine producers install Barn Owl (*Tyto alba*) nest boxes to attract owls which may minimize rodent crop damage. Since 2015, 297 nest boxes have been monitored to explore the potential for rodent control by Barn Owls. Since these initial surveys, devastating wildfires burned approximately 60,000 hectares of the region in 2017. The fires burned homes and businesses, as well as some vineyards and uncultivated habitat. 40.7% of nest boxes were within 2.86 km (the mean maximum hunting distance for this Barn Owl population) of the fire perimeter. Little is known about how Barn Owls respond to drastic landscape changes such as wildfires and this study addresses that gap. Occupancy surveys and GPS tracking before and after these wildfires reveal changes in habitat selection at the nest and hunting scales. Before the fires, 30.9% of nest boxes were occupied by breeding Barn Owls. The year after these fires, 50.9% of nest boxes were occupied, 42.8% of which had habitat burned within the average hunting range of owls for this population. Barn Owls were found breeding in recently burned areas that were not previously occupied, suggesting that wildfires may change the landscape in a way that encourages nest box occupancy. Data from GPS transmitters on Barn Owls before and after the fires provide further insight into the effects of the fires on hunting habitat selection. GPS data on 12 owls before the fires and 16 owls after, some of which were the same individuals in different years, provide a basis for a Before-After-Control-Impact (BACI) assessment of changes in habitat selection. These results have implications for the potential of Barn Owls to provide rodent pest control as vineyard owners increasingly install nest boxes and the western United States experiences increasing threats from wildfires.

Golden Eagle Nest Site Selection in Arizona: A Multi-scale Habitat Selection Modeling Approach using GIS and Random Forest

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Examining how a species is distributed spatially and temporally is fundamental to understanding their ecology. An environmental profile of the species can be established in order to ascertain the importance of specific factors that make up the species' fundamental niche by quantifying the correlation between environmental predictor variables and the distribution of a species. Golden Eagles (*Aquila chrysaetos*) select nest sites for specific reasons such as predator protection or to limit exposure to environmental elements. Currently, there are no documented studies quantifying Golden Eagle nest site selection in Arizona. Using data collected by Arizona Game & Fish Department (AZGFD), landscape characteristics of active nests were used to develop a nest site selection model. The research goals were to conduct a multiscale analysis to examine what environmental variables influenced Golden Eagle nest site selection. The study site includes the entire state of Arizona, excluding First Nations and Military Installations. All nest site location data were obtained from the AZGFD during surveys conducted between 2011-2016 as well as available historical data. The results of the model revealed climate variables (minimum vapor pressure deficiency, maximum temperature, precipitation), and aspect to be the top four factors in nest site selection; whereas the habitats pinyon-juniper and sage were the least important factors. These results were not unexpected given the desert environment these Golden Eagles chose to inhabit. The preferred prey item of Golden Eagles of Jack rabbit (*Lepus spp.*) requires moisture substance in vegetation as way of obtaining water. In addition, the aspect of the nest site is significant during times when the heat of the day could prove lethal to nestlings unable to shade themselves.

Occupancy-Abundance and Habitat-Occupancy of the Endemic Andaman Serpent Eagle (*Spilornis elgini*)

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We conducted the study to estimate population abundance and distribution of the Vulnerable and endemic Andaman Serpent Eagle during yrs 2015 and 2016. We selected the islands with >100km² area to conduct the occupancy survey using Grid Sampling Method (5km² x 5km² cell size). Occupancy-Abundance Model estimated Naïve Occupancy (ψ) = 0.83 ± 0.16 SD for Andaman Serpent Eagle with the detection probability (P) = 0.8 ± 0.16 SD indicating that the species occupied more than 80% of the total area surveyed. Also, the model estimated the occupancy-abundance of the species as 4.4 individuals per cell of 25km² area, indicating the density of around 4 – 5 individuals in each cell surveyed. The species seem to be more common in the North and Middle Andaman Islands than the South and Little Andaman Islands with the estimated abundance of 4.8 and 4 individuals per cell, respectively. The Habitat-Occupancy Model depicted low dependency of the Andaman Serpent Eagle on the habitat ($R^2 = 0.35$). However, this known inland forest species is found to be exclusively nesting in the mangrove forest. The Single Season Two Species Model showed that 78% of the landscape surveyed was occupied by the Crested Serpent Eagle (*Spilornis cheela*) ($\psi = 0.78$) and only 22% was occupied by the endemic Andaman Serpent Eagle ($\psi = 0.22$). Both the species were observed co-occurring in the Deciduous, Semi-evergreen and Mangrove forests and agricultural land. While assessing the competition across landscape between these two species, the model estimated their co-occurrence (ϕ) = 0.0314, suggesting 30% possibility of these species occurring in the Andaman Islands. Encounter history and habitat-occupancy of Andaman Serpent Eagle revealed that the species may be facing severe threat of the rapid habitat loss in South and Little Andaman.

Project WAFLS: Predicting Responses of Short-eared Owl (*Asio flammeus*) Population Size, Distribution, and Habitat Use in a Changing Climate

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The Short-eared Owl is an open-country, ground-nesting species found in marshes, grasslands, shrublands, and tundra across North America and around the world. Evidence suggests that Short-eared Owl populations are experiencing long-term, range-wide, substantial declines in North America, but sufficient monitoring data is lacking to quantify any possible trend. Complicating trend analysis efforts for this species is

the expected annual variation in breeding densities, believed to be associated with prey availability. We present evidence from four yrs of surveys, starting in the Intermountain West, but now encompassing eight western states, confirming annual variation in both density and distribution of Short-eared Owls. Furthermore, we have identified the landscapes features where owls are least susceptible to this variation. Lastly, we present climate-informed projections for the future viability of the species within the region. The results of our work will directly inform the prioritization of actions to help conserve this often neglected species.

Methods

Application of Novel Ecosystem Concept to Management of Raptor Habitat

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Although novel ecosystems are increasing globally, their utility for biodiversity conservation is poorly understood. Native fauna are predicted to use novel ecosystems when those ecosystems provide structure and resources similar to the native habitat. We modified existing terminology on wildlife functional groups to develop a conceptual model that illustrates fundamental differences in how native wildlife respond to novel ecosystems: novel ecosystem avoiders, novel ecosystem utilizers, and novel ecosystem flourishers. We postulate that species membership in these functional groups is related to the relative importance habitat physiognomy and floristics play in habitat selection cues and have demonstrated the utility of this conceptual model in previous work on passerines. In this paper we explore the application of this concept to raptor habitat and discuss the implications for conservation and restoration of raptor habitat.

Raptor Mortality Along an Interstate Highway in the Great Plains, North America

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Birds of prey are common victims to vehicle collisions along

high-speed roads, though we have a poor idea of just how many raptor mortalities occur. Here, we estimated the number of raptor mortalities occurring along a stretch of Interstate 80 in central Nebraska, U.S.A., by conducting raptor carcass surveys, carcass persistence trials, and searcher efficiency trials. Carcass persistence trials used Domestic Chicken (*Gallus gallus domesticus*), Common Quail (*Coturnix coturnix*), and raptor carcasses, which demonstrated the importance of using species-specific carcasses when conducting persistence trials as raptor carcasses persisted considerably longer than both Chicken and Quail. We also used Quail carcasses for searcher efficiency trials to represent small raptor species, which established the difficulties associated with detecting small raptor carcasses on high-speed roads. Overall, Great Horned Owls (*Bubo virginianus*) and Red-tailed Hawks (*Buteo jamaicensis*) were the most common victims, with relatively low rates of mortality in the summer and peaks occurring in the winter months. Finally, based on our searcher efficiency and carcass persistence trials we were able to create a correction value that can be applied to raptor carcass surveys conducted across similar interstates in grassland habitats of the Great Plains.

Migration and Wintering

Return Rates, Site Fidelity, and Pairing Behavior in a Wintering Population of American Kestrels in North Texas

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Data from the Breeding Bird Survey, raptor migration counts, and occupancy of nest boxes indicate that American Kestrel (*Falco sparverius*) populations are undergoing widespread declines in North America. Many observers of this species have suggested that this decline may be related to survivorship or changes influencing their wintering ecology, which has received limited study. We began investigating the wintering ecology of the American Kestrel in north Texas in December 2016. Here, we report our findings related to annual return rates, the degree of site fidelity, and observations of wintering pair behavior. We captured Kestrels using bal-chatri traps and marked birds with anodized bands with a unique two-character code. In addition, most Kestrels received a unique dye mark on the ventral body. Throughout the winters of 2016-17 and 2017-18, we

periodically visited locations where we previously marked falcons and recorded the presence of these Kestrels based on their band code or dye mark and made general observations. Of the 19 Kestrels marked during our first winter season, we documented that at least 11 birds (58%) returned to our study area the following winter of 2017-18. The distance from the original capture location to the re-encounter location the next winter varied from 22 to 989 m (mean = 269 m). Eight of the marked Kestrels were re-sighted less than 239 m from their original capture location, indicating strong winter site fidelity. Repeated observations on five marked Kestrels suggested they used small winter territories (mean = 1.02 ha, range = 0.29 – 2.10 ha). Of 50 marked Kestrels observed during 2017-18, at least seven birds exhibited obvious paired behavior including copulations between 29 December and 2 March. These observations may suggest that some American Kestrels participate in temporary “winter romances” or that these pairs may re-unite both on their breeding and wintering territories.

Migratory Patterns and Settlement Areas Revealed by Remote Sensing in an Endangered Intra-African Migrant Bird of Prey: the Black Harrier (*Circus maurus*)

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Migratory movements have been widely described for birds migrating across the Americas and between Eurasia and Africa, yet relatively little information exists for intra-African migrants. Identifying the areas used throughout a species annual cycle is essential for conservation initiatives. The ground-nesting Black Harrier is a raptor endemic to southern Africa, with a population size estimated at less than 1,000 breeding individuals. However, published information outside its breeding season ecology is lacking. Here, we describe for the first time the migratory patterns, settlement areas and habitat use during the breeding

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and non-breeding seasons of this endangered bird of prey. Thirteen adult Black Harriers were trapped during 2008-2015 breeding seasons in south-western South Africa and were fitted either with a GPS-GSM or with a PTT tracker device. Adults were monitored for 365 ± 198 d (range: 56–819). Adults exhibited an unusual West-East migration from their breeding areas eastwards, covering the entire southern land area of South Africa and Lesotho. The distance travelled averaged 814 ± 324 km, but opposite to observations in other species, migrants travelled almost twice as fast during post-breeding (207.8 ± 113.2 km/d) than during pre-breeding migrations (143.8 ± 32.2 km/d). Strikingly, adults showed a low degree of philopatry to their former breeding areas, suggesting a nomadic or irruptive behaviour. Although most displayed movements similar to breeding birds after pre-breeding migrations, our results suggest that some individuals may only breed in alternate yrs. Nonetheless, adults frequently returned to their non-breeding settlement areas, and often used up to three different locations distant of about 200 km from each other. We discuss the implications of our study for the conservation of Black Harriers and more broadly for intra-African bird migrants.

Spatiotemporal Movement Activity Patterns of Wintering Eleonora’s Falcons (*Falco eleonora*) in Madagascar

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Individually attached tracking devices on Eleonora’s Falcons from several colonies throughout the breeding range, recently confirmed suspicions that Madagascar is its almost exclusive wintering destination. Because of Madagascar’s vast size, and Eleonora’s Falcons global population of just 15000 pairs, observations of wintering individuals are scarcely reported in the literature. Advances in technology allowed us to use GPS transmitters, which provide data of greater spatial accuracy and finer temporal resolution than previously used satellite transmitters, thus allowing for a more thorough investigation of the species’ wintering movements and activity patterns. Our results suggest that during the wintering period Eleonora’s Falcon occupies extensive areas in Madagascar, moving progressively from more open areas towards areas with denser tree cover, and especially to humid forest, possibly as a response to spatiotemporal patterns in food abundance during the wintering period. Our data also indicate high intra-individual fidelity and relatively low connectivity. Time budget analysis revealed for the first time that Eleonora’s Falcons spend more

than 80% of their time resting or roosting, while just about 15% of their daily activity is devoted to foraging, the latter being performed almost exclusively during the day. GPS transmitters highly enhanced our ability to understand the wintering ecology of Eleonora’s Falcons in Madagascar, allowing for more accurate habitat requirement identification and better spatiotemporal activity pattern identification.

The Effect of Landscape Composition and Fragmentation on Wintering European Honey-buzzard (*Pernis apivorus*) Movement and Habitat Use

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Habitat fragmentation disproportionately affects specialist species. The declining European Honey-buzzard is both a habitat and dietary specialist and therefore, fits the profile for a fragmentation sensitive species. Using data from 32 tracked European Honey-buzzards (six adult males, five adult females, eight juvenile males, and 13 juvenile females), we assessed average home range size and habitat cover on their wintering grounds in Africa. Individual birds had an average of 8.25 ± 1.08 home ranges over the period of study (July 2011 to April 2018). The average 50% kernel size was 20.60 ± 79.78 km² while the average 95% kernel size was 102.78 ± 334.34 km². Using linear mixed effects models with individual as the random effect, we determined that percent tree cover had a negative effect on 50% kernel size while percent developed land cover had a positive effect. For 95% kernel size, largest patch index, edge density, and percent tree cover had a negative effect, while percent developed land cover had a positive effect. These initial results indicate wintering European Honey-buzzards require larger home ranges when there are not suitable large forested tracts of land. This requirement puts them at risk due to decreasing forested area on the African continent as well as increasing fragmentation.

Use of Upland and Riparian Landscapes by Wintering Bald Eagles (*Haliaeetus leucocephalus*) in the Midwestern U.S.A.

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Understanding variation in landscape use is critical to managing and conserving populations, especially because threats to wildlife vary among landscapes. Bald Eagles utilize both riparian and upland landscapes during the winter, but the extent to which they use these landscapes, and thus the threats they may face as they move among sites, is poorly understood. For example, exposure to spent lead ammunition, wind turbines and electrocution risk may be greater in upland landscapes, while exposure to lead fishing tackle, algal blooms, and intraspecific competition may be greater in riparian areas. To better understand variation in habitat and space use by Bald Eagles during winter in the Midwestern USA, we tracked 30 migrant eagles with GSM/GPS telemetry from 2014 – 2018. To understand the extent to which eagles use riparian and upland areas, we extracted habitat underlying each GPS location for each bird each yr and evaluated within and among individual variation. Because we expected that age might influence use of habitats, we compared age to the proportion of locations in riparian and upland areas. To understand variation in space use, we calculated home range for each bird and yr during the winter, and the proportion of land cover types in riparian and upland areas within each annual winter home range. We then examined how space use was influenced by age, yr, and the proportion of cover types within riparian and upland areas. Finally, we relate our results to the different threats that eagles face in riparian and upland landscapes.

Movement

Habitat Effects on Route Selection and Movement Pace of Migrating Eleonora's Falcons (*Falco eleonora*)

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Our understanding of bird migration patterns has significantly improved in recent years due to the use of tracking devices attached on an increasing number of individuals of many species. Until very recently, when satellite tracking studies revealed the migratory routes for a small number of Eleonora's Falcon individuals, its migratory routes had been effectively

unknown. Still, factors affecting migratory strategy are not well understood, because they require high accuracy, longitudinal data. Here, we use solar-powered GPS transmitters to monitor the migratory movements of Eleonora's Falcon breeding in Cyprus, the easternmost breeding population of the species. We tested the effect of vegetative cover on speed, and differences in movements between day and night, comparing also successive trip patterns. We found that tagged individuals repeatedly exhibit an anticlockwise loop migration pattern with routes in spring being more easterly than in autumn. We identified a preference, especially in autumn, for migration through vegetation-rich areas, with lower speeds during daytime, indicating fly-and-forage activity. Birds roosted during most nights, combining refueling stopovers at selected vegetation-rich areas before or after crossing ecological barriers. Conversely, both during day and night, they overflowed unsuitable habitats at fast speeds. Our results suggest that habitat is an important factor in Eleonora's Falcon migratory strategies, allowing them to combine migration during the day with fly-and-forage refueling, while roosting most nights except when crossing sparsely-vegetated areas.

Aeroecology Predicts the Movements of a Terrestrial Raptor, the California Condor

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California Condors (*Gymnogyps californianus*) were extirpated from the wild in 1987, captive bred, and reintroduced in the 1990s. As their populations have grown, their range expansion has created trade-offs between protecting individual condors and economic development. To proactively address these problems, managers wish to predict the future distribution of the species. Aeroecological principles suggest that movement of large soaring birds is constrained by availability of environmental updraft. Therefore, we predicted condor range expansion as a response to suitable updraft availability. Preliminary analysis suggests that wing loading of 39 free-flying California Condors tracked with GPS telemetry averaged 7.031 kg/m² (SD = 0.97), suggesting

* **Presenting Author**

** **William C. Andersen Memorial Award Candidate**

an average minimum sink speed of 0.886 m/s. The proportion of modeled thermal updraft estimates that were greater than that minimum sink speed was very high in August (94%), but low in January (<1%). In contrast, the proportion of modeled orographic updraft above that minimum sink speed was relatively consistent throughout the year, for example at 7% in August and 9% in January. Month-specific resource selection functions based on updraft were effective at predicting movements of condors. These preliminary results suggest that although thermals are stronger forms of updraft, condor range expansion may be instead limited by the availability of weaker but more seasonally consistent orographic updraft. Extrapolating to presently uncolonized areas, updraft models predicted that the <40% of California and Oregon with the greatest topographical diversity is likely to be preferentially used by California Condors as they expand their distribution. This effort illustrates the effectiveness of using aeroecological principles to predict movements of some types of terrestrial birds.

Movement Ecology of Aplomado Falcons in the Chihuahuan Desert of Mexico as Revealed by Satellite Telemetry

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The Chihuahuan Desert population of the Northern Aplomado Falcon (*Falco femoralis septentrionalis*) is currently threatened by the extensive conversion of breeding habitat from open desert grasslands to irrigated farmland. However, why the species has not been able to occupy apparently available breeding habitat in the Chihuahuan Desert of northern Mexico and the southwestern United States remains a mystery. In this regard, the study of natal dispersal in Aplomado Falcons may potentially reveal mechanisms of habitat selection and help identify critical habitat suitable for protection. We tracked the movements two wild Aplomado Falcons (female and male) in Chihuahua (Mexico) since fledgling using Argos 5 g PTT-100 satellite transmitters deployed in May 2015. Falcons dispersed from their natal territory about 100 ds after fledgling. These falcons moved throughout historic breeding territories (delineated by a previous long-term demographic study), including intact or converted to recently converted farmland. These tagged falcons occasionally explored areas outside the core breeding areas with pulse-like,

long-distance movements, into potential breeding habitat being converted to farmland. After moving around for two yrs in an area of 8,000 km², the male falcon occupied in a vacant historic breeding territory and unsuccessfully nested with an unbanded female 15 km away from its natal territory; its second nesting attempt in 2018 breeding season yielded two fledglings. Upon becoming a breeding bird, the male falcon had a home range of 77 km². The female falcon moved around for two yrs in an area of 7,500 km² before its transmitter failed without documentation of breeding. Our telemetry data suggest that suitable falcon breeding habitat, in spite of its apparent availability, is actually limited to central Chihuahua and its current loss rate seriously questions the potential recovery of the species in the Chihuahuan Desert.

Year-round Satellite Tracking of Amur Falcon (*Falco amurensis*) Reveals the Longest Migration of any Raptor Species Across the Open Sea

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The title for undertaking the most arduous of all raptor migrations belongs certainly to the Amur Falcon, which is a complete transcontinental, trans-equatorial, long-distance flocking migrant. The principal breeding (mainly NE China) and wintering (mainly S. Africa) ranges are separated by both 70° of latitude and longitude. Details of the species' spring migration route have been almost completely unknown. It was assumed that Amur Falcons follow an elliptical course, and that spring migration takes the birds northwest of their southbound (autumn) route, journeying overland from southern Africa, north to the Horn of Africa and from there northwest into the Arabian Peninsula en route to Iran, Afghanistan, and Pakistan. Since 2010 we have tracked 10 adult falcons fitted with 5 g solar-powered satellite transmitters. Contrary to previous assumptions, the spring migration is not predominantly overland, but is a non-stop flight across the Indian Ocean from Somalia to India, covering 2500-3100 km of open water. From India, falcons fly around the Himalayas, and on to the breeding grounds. The assumption of an ocean crossing in autumn is confirmed by our data. Eight ocean crossings by one female were recorded during 2010-2014, establishing that the migration of Amur Falcon regularly includes the longest (2400-3150 km) open-sea crossing of any bird of prey species. In total, both southbound and northbound migrations lasted about two mos, and the distance as measured by the paths used by the birds between the breeding grounds and the wintering areas was about 14600 km. The annual cycle of Amur Falcon takes advantage of existing ecological

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** **William C. Andersen Memorial Award Candidate**

and environmental conditions. Monsoons provide tailwinds for migrating falcons in both directions, and the late breeding of the falcons allows them to breed in Magpie (*Pica pica*) nests, from which the young have already fledged.

From Breeding to Wintering Sites: Flocking Behaviour Allows Fledging Black Kites to Find Safe Flyway and Stop-over Sites

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The Black Kite (*Milvus migrans*) is a widespread species in the Western Palearctic, despite population declines in different areas of its range. At the end of the breeding season European Black Kites migrate towards Africa concentrating at the two main bottlenecks of the Afro-Palearctic migratory system. Tens of thousand individuals are counted at the Strait of Gibraltar between Spain and Morocco and along the Eastern coast of the Black Sea. However, there are secondary flyways used by some 1000s of individuals, and including one important site that passes along the Mid-Mediterranean Flyway. This route, different from the main ones, implies a long sea-crossing between Italy and Tunisia. However, only data from visual counts are available from this Flyway. To fill this gap, we tracked Black Kites migrating through the Channel of Sicily. We equipped five juveniles born in central Italy with GPS-GSM, and we followed their movements from fledging until the end of their autumn migration. We combined this data with visual observations in Italy (at breeding sites and along the flyway) to assess the importance of flocking behaviour in the first months of their life. The results show that juveniles Black Kites tend to remain together with adults. In the first weeks after fledging they are still fed by adults and they made only limited movements. When starting the migratory flight, they follow adults moving south in small flocks. Once they reached Western Sicily Black Kites roosted together forming large flocks (up to 300 individuals) at a stop-over site. Then, they started together over the sea crossing between western Sicily and Tunisia, and used small islands of the Channel of Sicily to rest. Our results highlight the importance of flocking that allows juveniles to find safe migratory flyways and suitable stop-over sites.

Space Use and Movement Patterns of Egyptian Vultures Tracked from the Douro Valley, Spain-Portugal

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The Egyptian Vulture (*Neophron percnopterus*) population in Europe has declined by 50-79% in the last 40 yrs and is listed as Endangered on the IUCN Red List. As a migratory species the Egyptian Vulture faces multiple threats that vary in intensity across the breeding and wintering ranges and along the migration routes. The EU LIFE Rupis project aims to implement actions to strengthen the Egyptian Vulture population in the Douro Valley trans-border region of Spain and Portugal, a current stronghold for the species with 135 breeding pairs being present. Here we present the results from the first yr of GPS-tracking nine individuals (five breeding adults, one non-breeding adult, a sub-adult, and two juveniles) from the breeding grounds in the Douro Valley, across the Strait of Gibraltar migration bottleneck, to their winter ranges in the West African Sahel. Of the eight vultures that migrated to Africa in 2017 (one juvenile overwintered in Extremadura, Spain), one juvenile was assumed to have died in southern Morocco while the adults and the sub-adult took 12-16 ds to travel >3,200 km to their winter ranges. The five breeding adults traversed extensive winter ranges (mean \pm SE 95% kernel density contour = 20,036 \pm 6,064 km², n = 5) compared to their summer ranges (mean \pm SE 95% kernel density contour = 169 \pm 58 km², n = 5), favouring savannah-type habitat. Although two vultures regularly visited protected areas in southern Mali, the majority of the vultures spent the winter periods in overlapping core ranges in the insecure and unprotected cross-border regions between Mali, Senegal and Mauritania. These preliminary findings illustrate the vulnerability of Egyptian Vultures along their migration route and in their winter ranges, and support calls for a “flyway approach” to Egyptian Vulture conservation in Western Europe and Africa.

RRF 2018 Andersen Award Extended Abstracts

Effects of Rearing Conditions on Natal Dispersal Processes in a Long-lived Predator Bird

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Natal or pre-breeding dispersal is a key driver of the functioning, dynamics and evolution of populations. Conditions experienced by individuals during development, i.e. rearing conditions, may have serious consequences for the multiple components that shape natal dispersal processes. Rearing conditions vary as a result of differences in parental and environmental quality and it has been shown that favourable rearing conditions are beneficial for individuals throughout their lives. However, the long-term consequences of rearing conditions on natal dispersal are still not fully understood in long-lived birds. In this study, we aim to test the following hypotheses to address the relationship between rearing conditions and certain components of the natal dispersal process in Bonelli's Eagle (*Aquila fasciata*): i) the body condition of nestlings depends on the quality of the territory and/or breeders; and ii) the survival until recruitment, iii) the age of recruitment, and iv) the natal dispersal distance (NDD) all depend on rearing conditions. As expected, nestlings reared in territories with high past productivity of chicks had better body condition, which indicates that both body condition and past productivity reflect the rearing conditions under which chicks are raised. In addition, chicks raised in territories with high past productivity and with good body condition had greater chances of surviving until recruitment. Furthermore, birds that recruit earlier have better body conditions, and males recruit at a younger age than females. Finally, although females in good body condition exhibited higher NDD when they recruited at younger ages, this pattern was not observed in either older females

or males. Overall, this study provides evidence that rearing conditions have important long-term consequences in long-lived birds. On the basis of our results, we advocate that conservation managers work actively in the promotion of actions aimed at improving the rearing conditions under which individuals develop in threatened populations.

Non-target Exposure of Toxins to Raptors: Anticoagulant Rodenticides and Ferruginous Hawks

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Anticoagulant rodenticides (ARs) threaten raptors through unintentional secondary poisoning, especially in species that primarily consume rodents. Exposure to ARs in free-living raptor populations has been documented on at least three continents, but patterns and pathways of exposure are not well studied, so potential effects of ARs on raptor populations remain difficult to quantify and mitigate. We evaluated the risk of AR exposure to Ferruginous Hawks (*Buteo regalis*) in the western United States. These hawks inhabit shrub-steppes, grasslands, and deserts, many of which are modified by agriculture, wind power, and oil and gas development. Rodenticides are often deployed in developed areas to reduce populations of burrowing mammals such as ground squirrels (*Urocitellus spp.*) and prairie dogs (*Cynomys spp.*), which compose a large proportion of Ferruginous Hawk diet. We collected blood samples from 165 Ferruginous Hawk nestlings from Idaho and Wyoming to be evaluated for prevalence and concentrations of eight different ARs. Every type of AR has the same mode of action: they inhibit the reductase enzyme, which depletes clotting factors and increases clotting time. Thus, we also measured blood clotting times (metrics: international normalized ratio [INR] and prothrombin time [PT]) of hawks in the field using technology originally designed for human use. We evaluated this field test kit for non-human use and rapid assessment of AR toxicity in raptors. Preliminary data suggest substantial variation in blood clotting time among individuals, which could be indicative of AR toxicity. The next steps are to evaluate within- and among-nest variation in exposure to ARs and correlate these data to environmental factors, such as geographic area, diet, and distance to agricultural activity. Our paper reports on these and

other findings related to non-target AR exposure in Ferruginous Hawks.

Similar Parental Care in a Generalist Raptor: The Case of Chimango Caracara (*Milvago chimango*) in a Suburban Habitat

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The study of parental care in raptors is particularly important since it can have strong implications for ecology and reproductive success. The Chimango Caracara is the most abundant and common raptor in Argentina, nesting in a wide variety of environments, including urbanized areas. However, there are no studies describing parental care behavior of this raptor. We performed focal observations (315 hr) in a colony of 74 nests of Chimango Caracara in a suburban habitat located in the center of Argentina. We examined the division of labor between both sexes and the effects of these behaviors on reproductive parameters (nest success and productivity). We measured incubation time during egg stage, feeding rate (number of prey contributions per hr) and cover time (“incubation” after hatching) during chick development. Incubation time was not significantly affected by the sex of the parent or by the number of eggs in the nest. There was no significant difference in cover time or feeding rate between males and females; yet, cover time decreased with the age of chicks, possibly suggesting that parents adjust their

covering behavior with the ability of chicks to thermoregulate. Variation in the reproductive parameters of Chimango Caracaras was not explained by any of these variables. On the one hand, our findings suggest a similar (and symmetrical) parental investment of both sexes in the reproductive stage, independent of the number of eggs/chicks in the nest. On the other hand, results evoke the importance of other external factors (not covered by this research) for the success and productivity of nests, such as physical condition or anthropic disturbance, to name a few. Incorporating such sources of variation into models could help to understand parental care in this generalist raptor.

Sleeping with the Enemy: The Extreme Associations of the African Pygmy Falcon to Sociable Weaver Colonies

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African Pygmy-falcons (*Polihierax semitorquatus*) never construct their own nest and depend entirely on Sociable Weaver (*Philetairus socius*) colonies for nesting. Literature on this system is limited to descriptive accounts and the true nature of the relationship between the species remains unclear. Falcons have rarely been observed to prey on weaver nestlings or adults, but no quantitative data exists. Nevertheless, an intricate relationship exists between these cohabiting species. Weaver breeding success is low; 75% of nests are destroyed by nest predators, mostly snakes. Whereas, Falcon nest failures to predation has been described as “slight”. If Falcons provide protective benefits during breeding, colonies hosting Falcons should have higher nest success than those without. Here we examine Falcon responses to potential nest predators and compare snake encounter rates at colonies that host Falcons and those that do not. We compare breeding success of Weaver colonies hosting Falcons with those that do not. Additionally, we compare Falcon breeding success and snake encounters when Weavers are and are not breeding. Falcons reacted to all stimuli but were significantly more aggressive towards the snake stimuli. Snake encounters were reduced at colonies containing Falcons. However, Weaver breeding success was found to be lower at colonies with Falcons, with more nests failing at the chick stage. Similarly, Falcon nesting success did not increase when Weavers were breeding, a period where we found increased snake encounters at colonies. Our results suggest that Falcons predate Weaver nests resulting in higher nest predation rates. However, despite this available food for Falcons, increased snake attendance at colonies with actively breeding Weavers holds

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increased nest predation costs for Falcons, despite the Falcons' aggressive behavior towards potential predators.

Experimental Test of Reaction Times of Pigeons Towards an Attacking Hawk – a Study of the Polymorphic Black Sparrowhawk Under Varying Conditions

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Color polymorphism, where different plumage morphs occur within a population, is found in 3.5% of bird species, but is more frequent in raptors, where it occurs in 24% of Accipiter hawks. The Black Sparrowhawk (*Accipiter melanoleucus*) exhibits a common light and a rarer dark morph. However, in our study population on the Cape peninsula, South Africa, the frequencies of the morphs are reversed with around 80% being dark morphs. A hypothesis to explain the high number of dark morph individuals in our study population is a potential foraging advantage under low light levels as experienced during the winter breeding season. In this study, we test this hypothesis directly by measuring the reaction times of Feral Pigeons (*Columba livia domestica*) to attacks of taxidermy mounts of Black Sparrowhawks under varied light conditions and different background colors. We predicted that Pigeons would show slower reaction time to dark morph hawks (as compared to light morphs) under darker light conditions or with darker backgrounds. Whilst we found that Pigeons react slower to hawks under low light and with a dark background, we found reaction times did not differ between the morphs in any of the conditions. Our experiment thus does not provide support of the main hypothesis to explain the higher frequency of dark morphs in our study area. Our results show there is an advantage for Black Sparrowhawks to hunt under low light and previous tracking data show that dark morphs are more active in low light. However, the increased hunting success under this condition is most likely linked to increased activity in these conditions, not an increase in crypsis of the dark morph compared to the light morph.

Linking Local and Regional Weather Variables to Migration Phenology in North American Raptors

GENERAL ABSTRACTS

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Changes in fall raptor migration phenology have been documented at hawk count site across North America. Delays in fall migration phenology are the most common shift reported however these changes vary from species to species. Changes in fall migration phenology are often attributed to climate change, but direct links to climate are rarely demonstrated. Those studies that do attempt to link the shifts to climate change often use global weather phenomena such as the North Atlantic Oscillation. We examined fall migration phenology in 14 raptor species counted at Hawk Ridge in Duluth, MN in relation to local and regional climate variables. Variables explored were related to temperature, favorable wind conditions, and cold fronts because they have previously been identified as having effects on raptor migration. Of these variables, temperature was found to be the most important and best explained the variation in migration phenology for several species such as Turkey Vultures (*Cathartes aura*) and Golden Eagles (*Aquila chrysaetos*). In contrast, timing of migration for species such as Bald Eagles (*Haliaeetus leucocephalus*) and Sharp-shinned Hawks (*Accipiter striatus*) were unrelated to any of the local or regional weather variables we selected.



African Fish Eagle | Photo by Bill Clark

SPEED TALKS



Martial Eagle | Photo by André Botha

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Raptors in the Scavenging Community of the Semi-arid Region of La Pampa, Argentina.

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Carrion consumption by vertebrates (i.e. scavenging) is an important ecological process supporting key ecosystem functions such as disease control and nutrient recycling, contributing even more than predation to the transfer of energy and matter in food webs. Despite being a relevant ecological process, scientific interest on scavenging by vertebrates has only recently emerged and data on scavenger communities are lacking for most terrestrial biomes such as South America. Here, we characterize the structure and composition of the vertebrate scavenger community, underscoring the role of scavenger raptors in these assemblages in the semi-arid region of La Pampa, Argentina. We used motion-triggered remote cameras to monitor a total of 31 carcasses: 22 of domestic ungulates and 9 of wild ungulates during 2017-2018. Of the total species detected, four (36.6%) were birds, all of them raptors: two obligate (18.2%) and two facultative scavengers (18.2%). Southern Caracara (*Caracara plancus*) was the raptor that most frequently appeared on the monitored carcasses (96.8%), followed by the Turkey Vulture (*Cathartes aura*; 58.1%), the Chimango Caracara (*Phalcoboenus chimango*; 51.6%), and the Black Vulture (*Coragyps atratus*; 32.2%). Some differences were found among these species regarding the type of carcasses scavenged: i.e. Chimango Caracaras consumed more frequently domestic than wild ungulate carcasses (68.2% vs. 11.1%), whilst Turkey Vulture and Black Vulture appeared less on domestic carcasses (40.9% vs. 100% and 27.3% vs. 44.4%). No differences were found for the Southern Caracara (95.4% of domestic vs. 100% of wild ungulate carcasses). Provided that raptors are the only avian guild at large ungulate carcasses in La Pampa, our results suggest an important role of diurnal raptors in the scavenging dynamics in this region. Furthermore, comparing with other bird

scavenger communities worldwide, our bird scavenger community seems smaller than in most other regions (e.g. Europe, Australia and North America).

Spatial-utilization Patterns by Captive-bred and Rehabilitated Cape Vultures (*Gyps coprotheres*) in Southern Africa.

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Following the continual decline of Cape Vulture populations over the last 40 yrs, captive breeding and rehabilitation programs have been set up with the aim to restore populations across southern Africa. Released vultures from these programs are expected to demonstrate the same patterns of spatial ecology. This study aims to determine the effectiveness of these conservation interventions by highlighting the capabilities and behavioral similarities between our study groups. Our analysis incorporated 242,584 GPS tracking points from 21 captive-bred and 15 rehabilitated birds. Minimum Convex Polygon (MCP) and Kernel Density Estimation (KDE) methods were used to analyze the extent of home ranges with 95% and 50% contours. The vultures travelled across the subcontinent into 8 different countries with an overall MCP of 2,726,629 km². Findings suggest that home range was significantly larger for rehabilitated birds (median MCP = 88,882 km²) than for captive-bred birds (median MCP = 634 km²). Furthermore, there was no clear effect of time spent in captivity or the nature of injury sustained on post-release dispersal behavior. Captive-bred birds showed a higher level of site fidelity and remained close to their release site (median dispersal distance = 24.24 km), whereas rehabilitated birds dispersed more widely across their native range (median dispersal distance = 251.73 km). By remaining close to their release site, captive-bred birds maintained a significantly higher proportion of their GPS locations within protected areas than rehabilitated birds. Despite showing site fidelity, captive-bred birds demonstrated innate capabilities for natural foraging behaviors. These findings suggest that captive breeding could provide localized restoration benefits for declining colonies. Future long-term studies should seek to analyze survivorship and identify breeding behavior for these captive-bred birds once they reach sexual maturity.

Foraging Behavior of Black Kite (*Milvus migrans*) (Accipitriformes: Accipitridae)

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Conferring to the Optimal Foraging Theory, predators prefer profitable prey in terms of energy efficiency to maximize fitness, generally net energy consumption. In this study the foraging behavior and efficiency of the Black kite was examined during 2015-2017 by the direct, ad libitum observation of a group of four to 18 individuals in an agricultural barren field and a natural pond at the Mauza Ghuanghawali, Sambhal district, Uttar Pradesh, India. The study was carried out in an environment which was encroached by anthropic factors. The average diving period to catch rodents was 10.37 ± 5.53 sec ($n = 380$), ranging from 2.17 to 21.43 sec to catch the rodents in agriculture fields. The average diving period for fish and piece of meat as fish food which was provided by the fisherman in the pond was 12.17 ± 3.93 sec ($n = 380$), ranging from 4.23 to 28.64 sec. The Black Kite also tries to steal the prey from other members of a group. The frequency of thefts or snatching attempts was 7.631% ($n = 29/380$). The stealing success frequency was 31.031% ($n = 9/29$). The observation shows that shorter dives (4.523 ± 2.234 sec) are more successful than longer (13.016 ± 5.609 sec) dives. Foraging success is related to the diving period, diving frequency, and theft frequency. When individuals forage in a group, there is more chance to steal the prey from another individual, as closer the individuals promote more stealing.

Changes in Nesting Numbers and Breeding Success of African White-backed Vultures (*Gyps africanus*) in the Okavango Delta, Botswana

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African White-backed Vultures have recently been uplisted to Critically Endangered by the IUCN due to declines. Poisoning is widely accepted as the major reason for these declines. Botswana supports a high number of this species, but as yet no published information exists on their population trends or breeding success. However, mass poisonings within Botswana and neighboring countries have killed hundreds of White-backed Vultures in recent years. We therefore expected that nesting numbers may have declined in this region, if these poisoning events are killing local breeding birds. We used information from aerial surveys conducted between 2006 and 2017 in Khwai and Linyanti, two important breeding areas for this species in the Okavango Delta, to determine if there was any change in nesting numbers of White-backed Vultures, and also examine whether there had been any changes in breeding success. Results showed an overall 53.5% decline in nesting numbers, with a greater decline in Linyanti than in Khwai. In both areas breeding success was significantly lower in 2017 than it was ten yrs ago. Population viability analysis suggested that if the productivity levels detected in 2017 were a true indication of current productivity levels for this population, and if recent high poisoning rates continue, this population could go extinct in the area in the next 13 yrs.

Effects of Anthropogenic Land-use Change on the Occupancy of Long-crested Eagles in the Midlands of KwaZulu-Natal South Africa

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Occupancy estimation is a useful method for assessing habitat quality for species that have difficult to find nests, including raptors breeding on private land where access is limited. We conducted road surveys in the Midlands of KwaZulu-Natal for Long-crested Eagles (*Lophaetus occipitalis*) once a mo from August 2017 to April 2018, corresponding to nine survey occasions. The program PRESENCE was used to estimate occupancy (proportion of sites occupied) and detection probability. Occupancy and detection probability were found to be 0.62 ± 0.1 and 0.22 ± 0.03 , respectively. The top three

competing models indicated only cropland to have a positive effect on occupancy ($\beta = 4.71 \pm 2.28$), whereas detection was a function of savanna alone or an interaction between savanna and either natural forest or non-native forestry plantation. The covariates 'cropland' and 'savanna' had the greatest support in terms of summed model weights ($w_i = 0.89$ and 0.91) for site occupancy and detection, respectively. The minimum number of surveys needed to determine, with 95 % confidence, that a site is not occupied was found to be 12 visits. Our results suggest that the ease with which Long-crested Eagles have adapted to commercial farmlands may be an important contributor to their continued abundance in KwaZulu-Natal. These Eagles appear to be benefiting from wildlife friendly management of cattle farms (savanna) as well as commercial crop farms. This study provides an alternative method for obtaining information about Long-crested Eagle habitat quality when nest locations are not known.

Patterns of Reverse Sexual Dimorphism in Falconinae: A Phylogenetic Analysis

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Reverse sexual dimorphism (RSD), where females are larger in size than males, has been investigated by multiple researchers of predatory birds. Most analyses have been aimed at discerning the general cause of RSD among all four groups that possess the trait (Falconidae, Accipitridae, Strigiformes, and Stercorariidae). Here, we investigated RSD at a finer-scale within Falconinae (a subgroup of Falconidae including the falcons and falconets) to limit the complexity of potential factors. We examined morphological correlations of RSD (based on Kemp & Crowe 1993) while controlling for phylogenetic relationships (using Fuchs et al. 2015). We found signals of RSD with head and bill characteristics, and relationships between size and extent of dimorphism (strongest for foot and head measurements). These results support previously hypothesized selective pressures—including ingestion rate, sexual selection, niche partitioning, and dominance—as causes or contributing factors to the development of RSD. Gape width and length both have large differences in their Blomberg's K values for males and females, indicating more phylogenetic signal for gape length in females. Males may be under more selective pressure regarding gape to help balance the demands of feeding to survive and providing the maximum amount of prey for their families.. Interestingly, while species of small falcons exist across the range of different extents of RSD, there are no large non-dimorphic falcons. This suggests that dimorphism is one of the factors that allowed

falcons to become larger and take advantage of the gradient of prey sizes available to bird-hunters (perhaps for reasons of dominance or niche partitioning).

Neotropical Vultures: Current Knowledge, Conservation Status and Research Perspectives

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Compared to Old World Vultures (Accipitridae), New World Vultures (Cathartidae) have received less attention overall. Except for the critically endangered California Condor (*Gymnogyps californianus*), no other New World vulture is categorized as threatened in the IUCN Red List; nevertheless, the evidence to allow a thorough assessment of their conservation status appears still sparse. Based on a literature review for the six species of New World Vultures that occur in the Neotropical region (i.e. the Turkey Vulture (*Cathartes aura*), Lesser Yellow-headed Vulture (*C. burrovianus*), Greater Yellow-headed Vulture (*C. melambrotus*), American Black Vulture (*Coragyps atratus*), King Vulture (*Sarcoramphus papa*) and the Andean Condor (*Vultur gryphus*), I summarize the current knowledge of the biology of these birds, comment on their conservation status and suggest guidelines for future research. In general, the biology of Neotropical Vultures has been little studied and most of what is known comes from studies that lack continuity or are spatially restricted. Neotropical Vulture feeding/social behaviour is an aspect that has received a lot of attention and topics like ecotoxicology, movement ecology, genetics, physiology, microbiology and scavenger ecology are being increasingly studied. The better-known species are the Black Vulture and the Andean Condor, which are the most abundant and most threatened species respectively, whereas the least-known species are the Lesser and Greater Yellow-headed Vultures. Population estimates are lacking for all the species, with the exception of the Andean Condor. Likewise, knowledge of the threats for Neotropical Vultures and their sensitivity to them exists only for the Andean Condor. Available data permit a reasonable assessment of the conservation status for the six species, but it should be urgently updated. The development of effective conservation and management plans for Neotropical vultures will largely depend on a systematic filling of knowledge gaps that prioritizes large scale (e.g. national, multinational and continental) approaches.

Large Population Declines in Kenya’s Raptors over the Past 45 Years

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Human modification of the environment is driving declines in population size and distributional extent of much of Africa’s biota, including birds of prey. To assess raptor populations we conducted nine yrs (2010-2018) of repeated road surveys in northern and southern Kenya, both inside and outside of protected areas, covering over 9,000 km. We compared our results to similar road survey data collected in Kenya during the 1970s (1970-72 and 1976-77), which covered over 6,000 km. Twenty-eight raptor species with at least 25 individuals observed during the earlier surveys were included in our analyses. Over c. 42 yrs, populations of 15 species declined within protected areas while those of 23 species declined outside of protected areas. Among those showing declines, the median rates of decline were -50% inside protected areas and -93% elsewhere. Equivalent values for vulture species were -51% and -99%, within and outside of PAs, respectively. Collectively, large resident eagles and Palearctic migrants declined outside of protected areas (-54% and -97%, respectively), but did not decline inside of protected areas. Our results are broadly consistent with similar present-day studies that have documented large population declines in raptors in West and southern Africa. These studies reinforce the perilous state of raptors throughout Africa and underpin the need to reverse these trends.

Sexual Dimorphism in African White-backed Vulture’s (*Gyps africanus*) Plumage

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The African White-backed Vulture was upgraded from Endangered to Critically Endangered on the IUCN Red List database in 2015. Identifying sex ratio and age composition in relation to population dynamics is vital to inform conservation action. In this study, six feathers were removed from upper wing covets of African White-backed Vultures (n=35). Photos of streaking patterns were analysed for pixilation through pixel counts using Adobe Photoshop CS4A. Comparison between sexes at three age groups (juveniles, sub-adults and adults) was conducted. DNA samples were taken from each individual in the study and were utilised as the control. The effect of age and sex on streaking intensity was analysed using a generalised linear model with the formula (streak ~ sex + age). Feather streaking in adult African White-backed Vultures showed a significant difference between males and females (p = 0.003, DF = 205), with the streak flooding the feather in females and remaining close to the rachis in males. Analysis for sub-adults and juveniles showed a difference in streaking between sexes, however, the sample size was too small for statistical analysis. Examining feather streaking as a technique for sexing resulted in the successful identification of 78.79% of individuals (13 females, 13 males). We have developed a non-invasive method for visually sexing adult African White-backed Vultures that can assist conservation monitoring in light of limited time and resources.

Golden Eagle Survival, Movement, and Seasonal Use Areas in Utah, United States

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A total of 53 solar GPS transmitters were deployed on nestling Golden Eagles (*Aquila chrysaetos*) in western Utah, USA, between 2013 and 2017 by HawkWatch International and the Department of Defense to study post-fledgling survival and movement ecology. First yr eagle survival after transmitter deployment at 7–8 wks age averaged 50% overall, but ranged from 25–75% over the yrs. Young eagles were generally found within six km of their nest until two mos after fledge age, after which average distances increased substantially (i.e., dispersal generally occurred). The majority of eagles surviving >1 yr established at least two distinct seasonal areas of use, most frequently contained within Utah, but multiple eagles also ranged as widely as Canada and Mexico. We developed a Utah statewide grid containing 4x4-km cells and counted individual eagles occurring

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in each cell during four seasonal periods of interest: summer/fall (1 July–15 November), winter (16 November–15 February 15), spring/non-breeding (16 February 16–30 June), and spring/ breeding (same period, but limited to eagles exhibiting territorial behavior). We also mapped areas of high nesting importance, based on modeling of existing nest records and identification of territories with higher than average breeding activity over the past 10 yrs. We identified important seasonal Golden Eagle use areas within Utah as containing multiple, adjacent cells used by >1 marked eagle, or prime nesting habitat. We also present preliminary resighting results from color banding of 108 eagle nestlings during the 2017–18 breeding seasons near camera traps on water feature or large mammal carcasses in an attempt to augment our understanding of post-fledgling eagle survival and seasonal attraction to such features.

The Value of Wing Photos in Snowy Owl Studies

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In July 2011 we recorded 42 nests or nesting attempts of Snowy Owls (*Bubo scandiacus*) in the two northernmost counties (Troms and Finnmark) of Northern Norway. We captured adult nesting birds and equipped nine females and three males with backpack satellite transmitters. We photographed both wings of all owls in outstretched positions according to a protocol described by Solheim (2016). Based on wing bar patterns of these images we concluded that a female photographed flying in one of the nesting areas in January 2011 was not among the females we captured there five months later. Flight images of a female that nested in Sweden in 2015 revealed that the bird was carrying a back-pack satellite transmitter (at this time non-functional), and thus had to be one of the females we captured and marked in 2011. Dark bar patterns on two primaries on the right wing and one on the left wing on the 2015 images were almost identical with patterns on primaries in the same positions of wings on one of the 2011 females. Analyses of DNA from molted feathers from the 2015 nest compared with DNA from blood samples of the females captured in 2011 confirmed that this identification was correct. One of the other females captured in 2011 was recovered dead in January 2013 after two summer molts. We compare the wing images of this individual and discuss the molt progression of wing feathers accordingly.

Assessment of Peregrine Falcon Nesting Habitat in the San Francisco Bay Area

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This study investigates the habitat preferences of the Peregrine Falcon (*Falco peregrinus anatum*), a highly successful urban species, of a growing subpopulation in the densely urbanized San Francisco Bay Area. I used elevation, slope, windspeed, solar radiation, nearest neighbor distance, average precipitation, average temperature, distance to nearest waterway, and land cover as digital layers in Geographic Information Systems (GIS) to evaluate their influence on 46 nesting sites. I also included distance to two prey species that are federally-listed, the California Least Tern (*Sterna antillarum browni*) and the Western Snowy Plover (*Charadrius nivosus nivosus*). Twenty falcon nest sites were on natural features and 26 were on anthropogenic features. Average nearest neighbor analysis showed the spatial distribution of nesting sites was not clustered, but random ($z = -1.56, P = 0.12$). Distance to federally-listed species was statistically significant ($P = 0.001$) between natural and anthropomorphic falcon nest sites. Principal component analysis (PCA) revealed components PC1 and PC2 explained 60% of the variance in the environmental attributes. Solar radiation, wind and elevation clustered together as the most important site qualities for all nests (loadings of solar radiation = 0.75, wind = -0.92, and elevation = 0.79 in PC1) while slope, solar radiation, precipitation, and elevation were clustered together as qualities of secondary importance (loadings of slope = 0.70, solar radiation = -0.58, precipitation = 0.9, and elevation = 0.52 in PC2). These results can help managers assess where Peregrine Falcons may nest and may serve as inputs to a predictive model to forecast potential future nest sites.



Vereaux's Eagle | Photo by André Botha

POSTER SESSION I



Dickenson's Kestrel | Photo by André Botha

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Effectiveness of Artificial Nesting Platforms to Aid Nesting for Western Osprey (*Pandion haliaetus*) in Abu Dhabi, UAE

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Western Osprey is a common breeding species in the Arabian Gulf, Red Sea and the Gulf of Oman. In the United Arab Emirates (UAE), Ospreys are found in habitats ranging from mangroves, and nearshore and offshore islands. It is a regional priority species identified for conservation and 90% of the UAE population comes from the Abu Dhabi Emirate. There have been substantial decreases in the number of breeding pairs in Abu Dhabi since 2011. The cause of the decline was attributed to habitat loss due to changes in land use and increased human disturbance at the breeding sites. The Osprey Conservation action plan prepared in 2012 proposed providing artificial nesting platforms to aid nesting at breeding sites. A total of 30 specifically designed artificial nesting platforms were installed at nine different sites, mainly on offshore and near shore islands in Abu Dhabi. A post installation monitoring survey at the peak breeding season was carried out in 2017 to assess occupancy and nesting success of the artificial plate forms. Out of the total 27 platforms checked, seven (26%) had active nests with breeding birds recorded at four breeding sites, followed by five (18%) platforms were occupied without any breeding attempts, and 10 (37%) platforms were not used. Moreover, five (19%) platforms were damaged/fallen. Overall 44% nesting occupancy was recorded at all nesting sites in the Salaha island complex; a nearshore island had 100% breeding success at four nesting platforms. Our study established that installing artificial nesting platforms is a useful management technique to enhance Osprey productivity by increasing the breeding population in areas where lack of undisturbed nest sites is the limiting factor.

Connecting the Dots: Identifying Melanistic Pathways in a Polymorphic Raptor (*Buteo jamaicensis harlani*)

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The Red-tailed Hawk is one of the most widespread raptors, breeding throughout North and Central America and exhibiting extensive phenotypic variation across a range of geographic landscapes. One subspecies in particular, Harlan’s Hawk (*B. j. harlani*), displays the most extreme plumage variation, despite documented interbreeding with another subspecies, the western Red-tailed Hawk (*B. j. calurus*). The Harlan’s Hawk has both light and dark morphs, with the dark morph far more common, and has a multi-colored, variably marked upper tail, a trait unique to Harlan’s Hawks alone. Recent genetic analyses have attempted to resolve the evolutionary relationships of Red-tailed Hawk subspecies, including Harlan’s Hawk, but the genetic mechanism(s) driving melanistic plumage in these birds remains unknown. Whereas the melanocortin-1 receptor has been associated with plumage variation in other birds, no such correlation has been observed in Harlan’s. Here we test the associations of several candidate genes known to regulate melanin across a broad range of taxa with the high phenotypic variation observed in Harlan’s Hawk plumage. We anticipate that one or more of the selected candidate genes will show significant correlation with melanistic plumage in dark morph Harlan’s Hawk compared with eastern and western subspecies of Red-tailed Hawks.

Migration Corridors and Stop Over Locations for Red-tailed Hawks

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Each year, thousands of Red-tailed Hawks (*Buteo jamaicensis*) migrate through the Americas, but important migratory corridors and routes are unknown. The migration corridors of individual Red-tailed Hawks are likely to be similar year to year, but may differ based on the starting point of the migration, weather patterns, or with changes in the landscape resulting from natural and anthropogenic disturbances. To address this issue, we deployed GPS cellular transmitters (Cellular Tracking Tech.) on 12 adult Red-tailed Hawks captured during wintering in Nebraska and GPS satellite (Microwave Telemetry Inc.) on 12 Red-tailed Hawks captured in Montana from 2013 -2017 (seven adults, five immature). Eleven individuals were captured during the fall migration, one on winter territory. We determined travel corridors

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** **William C. Andersen Memorial Award Candidate**

using dynamic Brownian Bridges movement models. Our goals were to determine migratory pathways over a large region and identify how these movements may change. With increasing urban development, habitat changes, and the popularity of industrial wind power development, information is needed regarding avian migratory pathways to avoid raptor-human conflicts. We hope movement and habitat use information from this study will be used to help alleviate the conflicts that end with raptor mortality. This may be very important as we identify important migration corridors and routes, as well as determine where and why the birds stopover in certain locations during migration.

North American Falconers Association Commitment to Research and Conservation

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The North American Falconers Association (NAFA) NAFA is the largest membership falconry organizations. NAFA's annual membership averages around 2500. Funding for NAFA is derived from membership dues and individual member donations. As a hunting sport/art, there is evidence that falconry has been in existence for over 20,000 years. In 2010 UNESCO declared falconry an "Intangible Cultural Heritage of Humanity"; UNESCO urged support by countries around the world. In the USA, falconers have had great success and commitment to the wise sustainable use and conservation of resources. It was falconers who organized the Peregrine Fund in 1970 and were directly involved in the re-establishment of the Peregrine Falcon (*Falco peregrinus*) in the US. The techniques developed by US falconers were employed around the world to bolster wild falcon populations ending in healthy populations. In 1999, falconers initiated additional efforts towards conservation of species critical to falconry by founding the North American Grouse Partnership (NAGP) to act as advocates and scientific experts for grouse in North America. NAFA members were present at the founding meeting of the American Wildlife Conservation Partners (AWCP) and have represented NAGP for many years. A core aspect of our mission is to promote the conservation of birds of prey, and build appreciation for their intrinsic value in nature. Many of NAFA's past and current members include pioneers and recognized experts in the fields of raptor science and conservation, who have worked steadfastly to expand scientific knowledge of raptor ecology and restore populations at risk. To that end NAFA's small grants program has annually funded conservation projects.

Global Raptor Research and Conservation Priorities: Tropical Raptors Fall Prey to Knowledge Gaps

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Raptors, or birds of prey, serve critical ecological functions, are particularly extinction-prone, and are often used as environmental indicators and flagship species. Yet, there is no global framework to prioritize research and conservation actions on them. Herein, we identify for the first time the factors driving extinction risk and scientific attention on raptors and develop a novel research and conservation priority index (RCPI) to identify global research and conservation priorities. We use ecological trait information and the number of research publications on raptor species to identify the drivers of extinction risk and scientific attention. We then map global research and conservation priorities. Lastly, we modeled where priorities fall relative to country-level development and governance indicators. Raptors restricted to islands and those with long life histories, scavengers, and forest-dependent species are particularly extinction-prone. Research is extremely biased towards a small fraction of raptor species: 10 species (1.8% of all raptors) account for one-third of all research, while one-fifth of species have zero publications. Extinction-prone species, species with decreasing population trends, with small geographic ranges and tropical species are heavily understudied. Regions of Latin America, Africa, and Southeast Asia are identified as particularly high priority for raptor research and conservation. These priorities are highly concentrated in developing countries and those with poor governance, indicating a global mismatch between priorities and capacity for research and conservation. A redistribution of scientific attention and conservation efforts towards developing tropical countries and least-studied species is critical in order to stem the biodiversity crisis impacting

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**** William C. Andersen Memorial Award Candidate**

raptors. We identify clear taxonomic and geographic research and conservation priorities for all raptors, and our methodology could be applied across taxa to prioritize scientific investment.

Two Cases of Foreign Bodies Ingestion in Raptor Pets

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A four yr old captive breeding male Harris's Hawk (*Parabuteo unicinctus*) was referred to our clinic in a state of emergency, the reason; an ingestion of candies with plastic wrap. Those were stuck in the goitre and were successfully removed through the oral cavity. The procedure was done with the bird being under mild sedation and by using a long forceps. The hawk lives with the owner since he was three wks old, mostly inside the house. The owner reported that the Hawk used to play with different objects but he never tried to eat them. A three yr old female Spotted Eagle-owl (*Bubo africanus*) from a captive breeding center, was directed for surgery by an external practitioner. The reason was an ingestion of rubber bands. A few hrs after the recovery from anesthesia the Owl died. The owner reported that he bought the Owl from a breeding center when one yr old, was kept in and outside cage of 4 x 3 x 2 m. These are two extreme cases of abnormal behavior, but in our clinic database we were able to find other cases of behavior disorder in birds of prey. They were mostly represented by self-deplumation of legs covering feather of Harris's Hawks. The high level of imprinting and the strong relationship with the owner was the common factor for all of them. Both these cases could be useful in order to increase attention on mental and social abilities in raptors. Further studies are needed to better understand this behavior, but in our opinion, the behavior problems and their implications will have more and more importance in the treatment of birds of prey, especially for those individuals that are kept as domestic pets.

Impossible to Soar Over Temperate Seas? The Osprey Exception

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Large raptors on migration generally avoid crossing the sea and prefer making large detours to concentrate at straits and isthmus. The explanation generally given is that there are no thermal ascending currents over temperate seas to practice soaring-gliding flight. The Osprey (*Pandion haliaetus*) is an exception as they are able to cross several hundred km of open sea. These long sea crossings are currently assumed to be powered by constant flapping. However, Osprey may also exploit the weak thermal convection currents that form over warm seas, like other seabirds do. We equipped 3 juvenile Osprey with GPS-Accelerometer-Magnetometer loggers. When they crossed the Mediterranean sea, they used an average 4 thermals /100 km. They reached altitudes of 900m above the sea level. The climb rate was 1.6 times slower than over land and the birds had to flap when circling, indicating that thermal currents were as expected much weaker over sea than over land. The intensity of thermals at sea decreased over the season. The occurrence of thermals was correlated to water masses that were warmer than the air. Since the wing loading and general morphology of the Osprey are not drastically different from other small to medium sized raptors, this finding leads to reconsider the migration ecology of raptors and the definition of ecological barriers.

Age During Release and Release Season Alter the Post-release Movement Behaviors of Reintroduced Egyptian Vultures

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The Egyptian Vulture (*Neophron percnopterus*) is an endangered, migratory scavenger. In an effort to reverse the species' declining trends, several reintroduction programs have been implemented in Europe and the Middle East, yet these programs have not yet succeeded in increasing the population sizes. In Israel, a reintroduction program has been operating since 2003, with 57 Egyptian Vultures released to the wild during this period, most of them captive-bred. The Vultures were released at different ages, ranging from five to 23 mos after hatching, and during different seasons of the yr. This is expected to affect their behavior and therefore can possibly affect their survival. We used GPS tracks of 25 captive-bred Egyptian Vultures to investigate the effects of age and season of release on local and migratory movements. Egyptian Vultures were tracked for a period of between a few ds (in case of early deaths) and four yrs. The vultures moved throughout the

* **Presenting Author**

** **William C. Andersen Memorial Award Candidate**

Middle-East and wintered in Saudi-Arabia, Egypt and Sudan. When released in winter, most birds roosted at the release site for about three mos before first leaving it, while most birds released in spring started spending nights away from the release site in less than one mo. Spring released birds also tended to fly much more than winter released birds during the first mos after release. Birds released during their first yr of life stayed at the wintering grounds in Africa for over a yr, while two birds released during their second yr, returned from the wintering sites after only a few mos. We believe that these preliminary results present first important lessons that may be used to improve the success rate of the endangered Egyptian Vultures' reintroduction project.

Distributional Approaches for the Analysis of Avian Migration

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Hawk migration is monitored annually at over 100 sites throughout North America. Analyses of migration counts have revealed phenological delays in southward autumn migration, and to a lesser extent, advances in northward spring migration. Analytical methods vary considerably from study to study, though most studies examine trends in summary statistics, such as median date (or other quantiles), first arrival date, or mean passage date (MPD). We propose a suite of methods based on analysis of the complete distribution of migrants and compare several methods, including analysis of the empirical cumulative distribution function (ECDF) of migrants and parametric survival analysis. We classify indices of migration phenology into three categories, those that integrate across the distribution, those that partition the distribution, and extreme values. We compare the performance of these indices using 46 yrs of data on Sharp-shinned Hawks (*Accipiter striatus*) counted during fall migration at Hawk Ridge Bird Observatory, Duluth, MN. In general, integrative indices showed greater consistency and superior performance (smaller SE and higher r²) than other methods. Extreme values and, to a lesser extent, quantiles showed low consistency and low power and are likely strongly influenced by changes in effort at counting. We demonstrate the analytical equivalence of MPD to the integrative indices and provide several motivations for its use, including its relationship with

parametric survival analysis. However, while MPD is equivalent to a distributional approach in some respects, it is shown to be severely limited in others and we recommend the lognormal distribution as the foundation for analysis of migration counts.

A Concept: Alternative Power Line Aversion Structure for Captive Bred Vultures and Other Large Raptors

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Mitigation of environmental threats is an important factor for captive breeding and release programs. Power line electrocution remains one of the key threats to the Cape Griffon (*Gyps coprotheres*), making a significant contribution to low juvenile and immature survival rates. Power line aversion conditioning is thus required for captive bred birds prior to release. Whilst conditioning appears to have been relatively effective for the California Condor (*Gymnogyps californianus*), the same method has proven to be unsuccessful in the case of the Cape Griffon. A novel design for an aversion structure was devised, making use of a flexible rubber mounting, vibrating motors and electronic sensor on the upper part of the structure, which otherwise resembles a typical power pole, complete with insulators. The concept relies on the principles of Pavlovian fear conditioning and utilizes pronounced vibration to simulate a sudden electrical jolt, as soon as a bird makes contact with the sensors, forcing the bird to immediately leave the structure. A miniature (working) model was constructed in order to initially test the concept. Vibration was most pronounced when the motors were wired to run in a concurrent direction and pulsed at reduced r/min. An immature, aviary kept Budgerigar (*Melopsittacus undulatus*) was selected for a basic (uncontrolled) test of the miniature model. Upon initial operation at higher r/min, the bird showed an immediate 'flight' reaction and obvious discomfort, however the visible presence of the observer and enclosed space may have prevented displacement to the alternate perch. Only once the motors were pulsed repeatedly did the bird move to the alternate perch. Whilst this trial does suggest that this basic concept is sound, and could be applied to other species, it would require further full-scale development and testing to ensure adequate vibration.

Great Gray Owl Habitat Selection and Home Range Characteristics During the Breeding Season

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Natural- and human-induced habitat change is increasing across landscapes, with largely unknown consequences for under-studied raptor species. Identifying the breeding-season home range size and resource requirements of such species is critical for the development of effective conservation strategies, especially in the face of habitat alteration. Throughout the Rocky Mountains, USA, older-aged montane and sub-alpine forests are changing rapidly due wildfire, disease and beetle outbreaks, drought, climate change, logging and development. Great Gray Owls (*Strix nebulosa*) are associated with older-aged, boreal forest habitats, and studies conducted outside of the Rocky Mountains suggest that this species responds negatively to the loss of key habitat elements. Additionally, within our study area in Teton County, Wyoming, USA, Great Gray Owl productivity has declined considerably over the past 30 yrs. Our study will evaluate the habitat parameters that influence Great Gray Owl territory selection and reproductive success. In 2018 we outfitted adult male owls (n = 9) with GPS remote-download transmitters and collected location data for these birds throughout the breeding season (24 locations/day between 15 April – 15 September). We will use these data to quantify size and attributes of breeding-season home ranges for Great Gray Owls. To compare fine-scale habitat use versus availability within territories, we conducted on-the-ground resource surveys at the birds' locations (as well as at random points within the territory) using a stratified random sample design. We also monitored nesting success in order to relate productivity to territory-scale habitat attributes. In 2018, only two of our study owls successfully fledged young, so preliminary data reflect a year when Great Gray Owl recruitment was low. We will continue to track our current study birds during 2019 and will outfit 10 more adult male owls with transmitters to continue to monitor productivity and conduct resource selection surveys.

Movements of the Urban Hooded Vulture (*Necrosyrtes monachus*) in Southern Uganda

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Information relayed by the two GPS-GSM tags deployed on two urban Hooded Vultures (critically endangered) over a period of 12 mos in Kampala suggests that the species moves substantially. So far the longest distance traveled by one of the birds is 130 km towards the east of Kampala. Our rationale for tracking Hooded Vultures was to identify new breeding grounds since little information was available both to researchers and the general public. The current urban Hooded Vulture population in Kampala shows a 56% ratio of juveniles to adults. Although our tracking data has so far not yielded any new breeding sites for the species, they have contributed substantially to the discovery of new feeding sites that are in urgent need of protection.

Spring Migration and Movements of Bald Eagles (*Haliaeetus leucocephalus*) Wintering in South Coastal British Columbia

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A 36 yr bounty program on Bald Eagles existed in Alaska until 1953, resulting in the deaths of hundreds of thousands of birds. Since its cessation, there has been a remarkable recovery in the number of Bald Eagles throughout the Pacific Northwest. The Fraser Valley in British Columbia now harbors a large population of resident and non-resident Bald Eagles with estimates of up to 35,000 birds passing through the region during spring and fall movements. Additionally, concentrations as large as 10,000 birds congregate during peak salmon spawning periods on the Lower Fraser River, representing the largest known gatherings for the species anywhere in North America. There is limited information about the origins of this wintering population, how long they remain in the area and to what degree, and how the broader western metapopulation utilizes the Fraser River for winter foraging opportunities. To date, limited telemetry data has been collected from this region of the Pacific Northwest, particularly on wintering birds. We describe spring migration chronology of adult and sub-adult Bald Eagles trapped and banded between February and March 2018 in Delta, B.C. as well as techniques used in the capture and deployment of GPS-GSM transmitters to address some of these knowledge gaps. Preliminary results of spring movements including unexpected southern migrations prior to northern departure, near simultaneous northward

* **Presenting Author**

** **William C. Andersen Memorial Award Candidate**

migration from the Fraser Valley and arrival on northern breeding grounds in Alaska, are discussed.

Oman’s Resident Egyptian Vulture (*Neophron percnopterus*) Population Appears Much Larger than Estimated

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We tracked via satellite 11 adult or near-adult Egyptian Vultures captured at a landfill in Oman in January 2018, suspecting that many would be migratory. By the end of June 2018 it was apparent that none were migratory, eight seemingly held territories, and three appeared to be non-breeding floaters. Assuming tracked birds were representative of the population in general, then the great majority of Egyptian Vultures in Oman during the non-breeding season must be resident. Counts of Egyptian Vultures at a number of landfills and rubbish dumps in northern Oman are large (sometimes 400-1000 birds), and if these are all or mostly residents then the actual national population must greatly exceed the 100 pairs that have been estimated, especially in light of apparently large increases in the population on Masirah Island, Oman. A large resident Egyptian Vulture population and the apparent lack of current threats in Oman are welcome news for a species suffering steep declines in many other parts of its range. Conservation challenges could increase as Oman develops, but may be averted to some extent by keeping Egyptian Vultures and other scavenging raptors in mind during development planning. Research is needed to understand how expansion of the electrical distribution network and changes in waste management might affect scavenging birds, so that planning decisions will be informed.

American Eagle Foundation Eagle Grants for 2019 includes International Eagle Grants

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The American Eagle Foundation has awarded almost \$600,000 in grants to conserve and protect the Bald Eagle. This year in honor of the Raptor Research Foundation’s first meeting in Africa, the American Eagle Foundation is offering an International

Eagle Grants program. The International Eagle Grants program is targeted at funding research and conservation for eagle species in developing, underserved areas. Award decisions will be based on a combination of quality of the proposal and the proposed project, the conservation status of the species, the urgency of the need for the project, and the qualifications of the applicants. Up to \$10,000 in grants will be awarded.

Annual and Seasonal Variations in Populations of Endangered Egyptian Vultures (*Neophron percnopterus*) in Administrative Divisions of Uttar Pradesh, India

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Among nine species of Vultures reported in India, eight species are found in Uttar Pradesh including the endangered Egyptian Vulture. The Egyptian Vulture is a medium-sized raptor and opportunist scavenger with a wide foraging range. The present research focuses on the comparison of populations of adult Egyptian Vultures in administrative divisions of Uttar Pradesh, India. There are total 18 administrative divisions in Uttar Pradesh, of which 11 divisions (Agra, Aligarh, Bareilly, Chitrakoot, Devipatan, Faizabad, Jhansi, Kanpur, Lucknow, Meerut, Moradabad) were surveyed from January 2014 to December 2017. Total count of the Egyptian Vulture population was conducted in three seasons (Summer, Winter and Monsoon). Observations were made from a distance of 20 to 50 m using binoculars. Photographs were taken for future reference. Annual mean population of adult Egyptian Vulture was found to be 103.44 (± 241.94). The largest population was recorded at the Lucknow division (641.17 ± 565.829) and the smallest at the Meerut division (22.08 ± 12.73). Administrative Divisions show significant difference in adult population levels (F10,121 = 12.611, p = 0.000). Significant seasonal differences were also observed in the population (F2,129 = 7.68, P = 0.001). The largest population was recorded in winter (206.36 ± 93), but no significant population variations were observed annually (F3,128 = 0.013, P = 0.998). This research can be useful in the implementation of conservation policy at Divisional administrative

* **Presenting Author**
 ** **William C. Andersen Memorial Award Candidate**

(spatial) and seasonal (temporal) scales.

The Fast and Forceful Kicking Strike of the Secretary Bird

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Secretary Birds (*Sagittarius serpentarius*) are widely recognized for their unusual looking morphology and novel hunting behavior, which involves rapidly striking venomous snakes and other prey with their feet, specifically the rear talon. The exceptionally long legs of Secretary Birds— more than twice that of an athletic ground bird of equivalent body mass— is widely thought to represent selection for rapid and forceful foot-strikes during hunting. Yet, the biomechanics of this novel behavior have never been measured. Here we present the biomechanics of hunting strikes of a Secretary Bird, and find that the force demands of these strikes are exceptional, exceeding the peak forces required for rapid locomotion. This finding challenges the widely held notion that locomotion places the greatest biomechanical demands on the legs. We also demonstrate that the bipedal locomotor behavior of these birds is unexceptional, exhibiting only the expected dynamic consequences of long legs, as predicted by the most widely accepted locomotion model.

Using Areas of Known Occupancy to Identify Sources of Variation in Detection Probability of Raptors

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Some species are difficult to detect and imperfect detection can lead to inaccurate estimates of occupancy. We used sightings data of White-headed Vultures (*Trigonoceps occipitalis*) in areas of known occupancy (breeding territories) to calculate the detection probability of a large raptor and the factors affecting it. Because occupancy was known we were able to focus on identifying sources of variation in detection probability. Using data from 359 Vulture territory visits we assessed nine covariates in 29 candidate models. The highest-supported model indicated that observer speed during a survey, time of year, and length of time in a territory influenced detection probability. Average detection probability from this model was 0.207 (SE:

0.033) and the mean number of visits to determine the absence of White-headed Vultures in a potential breeding area is 13 (95 % CI: 9 – 20). Topographical and habitat covariates contributed little to the best models and had little effect on detection probability. The low detection probability of some species means that emphasizing habitat covariates could lead to spurious results in occupancy models that fail to incorporate temporal components. Variation in detection probability is complex and influenced by effects at both temporal and spatial scales, but temporal covariates can and should be controlled as part of robust survey designs. Accounting for detection probability in occupancy studies is essential, particularly during presence/absence studies for species that occur at low densities, such as raptors.

Natural-nests versus Nest-boxes: Differences in Reproductive Parameters and Body Condition in American Kestrels (*Falco sparverius*) in Argentina

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Reproduction is the most important process in the life of any given species as it allows the persistence of its populations. Usually, reproduction is determined by several factors but with a great influence of environmental factors. The American Kestrel is an obliged cavity-nester. Nest site selection in cavity nesters should be influenced by the quality of the cavities as this quality can determinate breeding output. Here we compare reproductive parameters, and physical condition of fledgling and adult American kestrels from natural-nests (n=45) and nest-boxes (n=16). We sampled overtwo breeding seasons 2016/17 and 2017/18 in semi-arid forests in La Pampa, central Argentina. Reproductive success varied significantly among nest-types ($X^2 = 6.8959$, p-value = 0.0086, df = 1), and was lower in natural-nest (31,1%) compared to nest-boxes (68,7%). The number of fledglings produced was also lower in natural-nest than in nest-boxes ($X^2 = 39.153$, p-value = <0.001, df = 1). On the other hand, body condition was higher in females than in males for both fledglings ($X^2 = 5.5473$, p-value = 0.018, df = 1) and

* **Presenting Author**

** **William C. Andersen Memorial Award Candidate**

adults ($X^2 = 16.306$, $p\text{-value} = <0.001$, $df = 1$) but there was no effect of the type of nest. Our results suggest that breeding performance of American Kestrels in our study area is lower when using natural nests than when using nest-boxes. Probably, nest-boxes provide a better cavity for kestrels while natural nests are more prone to be impacted by weather or assaulted by predators. External factors such as climate, competition, and predation may play a key role in the low success obtained from the natural nest sites included in this research.

White-headed Vultures Show Visual Field Characteristics of Hunting Raptors

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The visual fields of Aegypiinae vultures have been shown to be adapted primarily to meet two key perceptual challenges of their obligate carrion-feeding behaviour: scanning the ground, and preventing the sun's image falling upon the retina. However, field observations have shown that foraging White-headed Vultures (*Trigonoceps occipitalis*) are not exclusively carrion-feeders, and are also facultative predators of live prey. Such feeding is likely to present additional perceptual challenges to those posed by carrion-feeding. Binocularity, is the key component of all visual fields and in birds it is thought to function primarily in the accurate placement of the talons and bill, especially in the location and seizure of food items. We determined visual fields in White-headed Vultures and two species of carrion-eating Gyps vultures, to show that the visual field of White-headed Vultures have more similarities with those of predatory raptors (e.g. Accipitrid hawks), compared with the taxonomically more closely related Gyps vultures. We found that maximum binocular field width in White-headed Vultures (30°) is similar to predatory raptors and significantly wider than Gyps vultures. The broader binocular fields in White-headed Vultures probably facilitate accurate placement and timing of the talons when capturing evasive live prey.

High Resolution of Colour Vision, but Low Contrast Sensitivity in a Diurnal Raptor

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Animals are thought to use achromatic signals to detect

small (or distant) objects and chromatic signals for large (or close) objects. While some studies have assessed the spatial resolution of the achromatic channel, the spatial resolution of the chromatic channel has rarely been estimated. In times where ecologists use models to describe what animals can and cannot see, understanding the resolution of both the chromatic and achromatic channel is particularly relevant. Using an operant conditioning method, we estimated (1) the achromatic contrast sensitivity function and (2) the spatial resolution of the chromatic channel of a diurnal raptor, the Harris's hawk (*Parabuteo unicinctus*). The maximal spatial resolution for achromatic gratings was 62.3 c/deg, but the contrast sensitivity was relatively low (10.8-12.7). The maximal spatial resolution of the chromatic channel was 21.6 c/deg - lower than that of the achromatic channel, but the highest found to date in the animal kingdom. Our study revealed that Harris's Hawks have high spatial resolving power for both achromatic and chromatic vision, suggesting the importance of colour vision for foraging and detecting prey. By contrast, similar to other bird species, Harris's Hawks have low contrast sensitivity suggesting a trade-off with spatial resolution.

Assessing the Current Status of Breeding Raptors in a Rapidly Developing Area of Southern Kenya - with a Special Focus on Threatened Species

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Kenya is currently undergoing rapid industrialization as part of the country's Vision 2030 development agenda. Despite southern Kenya supporting significant populations of threatened raptors, there is a deficiency of data on the current status of several of these species in key areas. This study focuses on the raptor guild of the Athi-Kaputiei Ecosystem, a 2,450 km² wildlife-rich area south of Nairobi, where wind energy facilities, a standard gauge railway, cement factories and an expressway are among the large-scale development projects currently underway. This study documents the abundance and distribution of breeding raptors in the area in order to identify key sites to focus conservation efforts as development progresses. Surveys have recorded 95 nests belonging to threatened species - 89 critically endangered White-backed Vulture (*Gyps africanus*), four vulnerable Martial Eagle (*Polemaetus bellicosus*) and two vulnerable Secretarybird (*Sagittarius serpentarius*) nests. Of these, 39 (41%) are in a highly-protected Key Biodiversity Area (Nairobi National Park), 55 (58%) are in two areas of moderate protection (conservancies) and 1 (1%) is in an unprotected area. A further 23 nests belonging to species at lower threat

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** **William C. Andersen Memorial Award Candidate**

levels (one near threatened and 22 least concern) were recorded. Overall raptor species richness in the area was also found to be high, with 37 species (10 migrants and 27 residents) recorded, including seven threatened and three near threatened species. Apart from the aforementioned development projects, other recorded threats to raptors in this area include indirect poisoning, illegal logging at nesting sites and potential natural gas exploitation. Data from this study are being used to engage stakeholders on strategies to minimize the negative impacts of infrastructure development on raptors in this area.

Distribution of the Red-headed Vulture (*Sarcogyps calvus*) in India.

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There are nine species of vultures (Red-headed Vulture, Long-billed Vulture (*Gyps indicus*), Cinereous Vulture (*Aegypius monachus*), Egyptian Vulture (*Neophron percnopterus*), Eurasian Griffon Vulture (*Gyps fulvus*), Himalayan Griffon Vulture (*Gyps himalayensis*), Slender-billed Vulture (*Gyps tenuirostris*), White-rumped Vulture (*Gyps bengalensis*) and Bearded Vulture (*Gypaetus barbatus*)) found in India. All are included in the Schedule 1 of Wildlife Protection Act, and provided the highest protection. The Red-headed Vulture (RHV) is critically endangered and the rarest of the vulture species found in India. They are not colonial and usually reside in semi-desert areas, deciduous forests, foothills, and along riversides. It is a timid bird at feeding sites, usually solitary or seen in pairs. The present study deals with the distribution of RHV in India and the data used is taken from the citizen science database of eBird. Every year numerous birders around the globe voluntarily contribute the information of birds. This data is utilized to study the sightings of RHV in India. The most recent and complete dataset of RHV from the yr 2017 was used to prepare the distribution

maps in different states. The RHV is very low in number, and there is no exact data present regarding their population. As a result, the RHV was reported from 12 different states with the total of 183 sightings. The maximum number of reports (55 sightings) came from Uttarakhand and the minimum (one site) from Delhi and Tamilnadu states each. Most of the sightings were either in or around protected areas. The RHV is also facing serious threats of habitat loss and lack of food availability along with diclofenac poisoning. They require various conservational measures to retain their population.

Snowy Owls May Breed when One Year Old

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In 2007, 2011 and 2015 we recorded four, 42 and 24 nests or nesting attempts respectively of Snowy Owls (*Bubo scandiacus*) in Northern Norway. We captured adult owls at the nests for satellite tagging, photographed flying owls from helicopters when surveying breeding areas, and collected molted feathers at each nest site. Based on photos and collected molt feathers we found two females in 2011 and one female in 2015 that bred as one yr old (2CY). In 2015 we aged totally 18 females and 16 males based on wing images of flying or captured birds. In one pair we considered both sexes to be 2CY/3CY birds, but images could not give exact age classification. In 2015 molt feathers were also collected at 23 nest sites in Sweden. Two of these held at least some typically juvenile molt feathers from the female owl, indicating that the nesters could be in age group 2-4CY. We discuss the evolutionary and ecologically significance of breeding as one yr old birds in Snowy Owls.

Phylogenetic Analysis of Elaninae Kites Based on Nucleotide Sequences of Mitochondrial and Nuclear DNA

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Elaninae Kites are small tropical Raptors, placed in a separate subfamily of the order Accipitriformes, and are constituted of three genera. Elanus is cosmopolitan and includes four

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** **William C. Andersen Memorial Award Candidate**

species, two other genera are monotypic – American Pearl Kite (*Gampsonyx swainsonii*) and African Scissor-tailed Kite (*Chelictinia riocourii*). We checked all Elaninae species from our collection and Genbank, and mitochondrial cytb and nuclear RAG-1 genes were sequenced. Analysis by Bayesian inference, neighbor joining and maximum likelihood were carried out. A basal position to other Accipitridae that was shown before to several species is confirmed to all Elaninae species. The African Scissor-tailed Kite which was not previously sequenced is a sister taxa for two other genera. Also we examined the African subspecies of the most widely distributed representative Black-winged Kite (*Elanus caeruleus caeruleus*), which reveal local and panafrikan haplotypes. The remote location of the Elaninae in the phylogenetic tree comparable with other families (Ospreys Pandionidae, Secretarybird Sagittariidae) suggests that Elaninae appears to be a new and distinct family in Accipitriformes.

Agricultural Intensification and Cyclic Fluctuations of Main Prey Trigger Maladaptive Habitat Selection of a Raptor in Boreal Landscapes

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Food availability is a major factor driving the reproductive output and survival of wild predator populations. However, few studies have investigated the interplay between land-use change, limitation in food resources and spatial variation in fitness parameters. Here, we take advantage of a unique dataset to specifically explore mismatches between landscape composition (from homogenous agricultural areas to more heterogeneous

forested habitats) and highly fluctuating prey availability, individual quality, breeding phenology and reproductive success in a Finnish population of Eurasian kestrel (*Falco tinnunculus*). Our data-set covers a full three yr population cycle of *Microtus* voles, kestrels' main prey, and combines several individual quality measurements (n = 453 breeding adults), that operate on varying time scales including (i) body condition, (ii) blood parasite infection, and (iii) individual genetic heterozygosity with landscape heterogeneity and resulting fitness consequences. Overall, we found a mismatch between expected and realized fitness, reflected by the settlement decision (i.e., timing of breeding) and nestling survival (i.e., the ratio of eggs that successfully fledged). During the increase and decrease phase of the vole cycle, egg-laying was earlier in more homogeneous landscapes but nestling survival was higher in the most heterogeneous landscapes. During the low vole abundance yr, egg-laying was earlier in more heterogeneous landscapes, but nestling survival was higher in the most homogeneous landscapes. Furthermore, we showed that breeding males of high individual quality (i.e. high genetic heterozygosity) performed well in terms of nestling survival no matter in which habitat type they settled, while individuals of low genetic heterozygosity performed best in more heterogeneous habitats. These results suggest that heterogeneous landscapes might allow predators to buffer against food limiting conditions by offering more alternative prey, resulting in average levels of reproductive success for a higher proportion of individuals. This conclusion has important implications for biodiversity conservation in Nordic agricultural landscapes.

Family Morph Matters: Factors Determining Survival and Recruitment in a Long-Lived Polymorphic Raptor

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From an evolutionary perspective, recruitment into the breeding population represents one of the most important life-history stages and determines the effective population size. Offspring must survive to sexual maturity, secure a territory

* **Presenting Author**

** **William C. Andersen Memorial Award Candidate**

and find a mate. In this study, we explore factors influencing both offspring survival and their subsequent recruitment into the local breeding population in a long-lived urban raptor, the Black Sparrowhawk (*Accipiter melanoleucus*). Adult Black Sparrowhawks show discrete colour polymorphism (dark and light morphs), and in South Africa, morphs are distributed clinally with the highest proportion of dark morphs (c.75%) present in our study population on the Cape Peninsula. Parental morph was associated with both survival and recruitment. For survival, young produced by pairs of contrasting morphs have higher survival rates than young fledged from like-pairs. The association between recruitment and morph was more complex; with an interaction between male morph and breeding time, whereby recruitment of offspring from dark morph fathers was more likely when fledging earlier in the season. The opposite relationship was found for light morph fathers, with their offspring more likely to be recruited if fledged later in the season. This interaction may be due to differential morph-specific hunting success of fathers, linked to background matching and crypsis in different weather conditions. Dark morph males may hunt more successfully in rainier and cloudier conditions, which occur more frequently earlier in the breeding season, and light morph males may be more successful later on, when weather conditions become increasingly brighter and drier. Our results reveal a complex situation whereby the family morph combination influences survival, and the father morphs specifically recruitment, revealing morph-specific benefits dependent on the timing of breeding. These data are among the first to support the idea that differential fitness consequence of morph combination may explain balanced polymorphism in a vertebrate population.

Genetic Determination of Migration Strategies in Large Raptors: Evidence from Hybrid Spotted Eagles

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The relative contributions of genetic and social factors in bird migration has been a long-debated question. According to the widely accepted view, migratory movements are predominantly genetically determined in passerine birds, while in large soaring birds, it is presumed that social (cultural) factors play the largest role. We show that genetic factors in soaring birds are more important than previously assumed. We used GPS-telemetry to compare the autumn journeys and wintering ranges of two

closely related large raptors, the Greater Spotted Eagle (*Clanga clanga*) and the Lesser Spotted Eagle (*C. pomarina*), and hybrids between them. The timing of migration in hybrids was similar to that of one parental species, but the wintering distributions and home range sizes were similar to those of the other. Tracking data were supported by habitat suitability modeling, based on GPS-fixes and ring recoveries. These results suggest a strong genetic influence on migration strategy via a trait-dependent dominance effect, although we cannot rule out the contribution of social interactions.

Distribution and Abundance of Diurnal Raptors in the Greater Nairobi Area, Kenya

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Urban raptor populations face numerous challenges in human-populated habitats. Raptors in Nairobi are threatened by habitat loss, human persecution, prey reduction and impacts from power lines. This study was conducted between December 2016 and June 2017 and was aimed at documenting the urban guild of diurnal raptors of the Greater Nairobi area. We used EstimateS Version 9.1.0 software to establish biodiversity statistics and identified 15 raptor species in three urban forests (Karura, Ngong Road and Thogoto); and nine raptor species in the general metropolitan. The Shannon-index of diversity (H') was used to determine species diversity in the forests. Using Analysis of Variance (ANOVA), the mean Shannon diversity indices for the three forests were compared; and the study revealed that there were no significant differences in raptor diversities. Species encounter rates were computed per 100 km. A chi-square test of independence was performed to examine the relation between species encounter rates across the forests. The study revealed that there are significant differences in raptor abundances between the three forests. The Shannon Diversity index results showed that forests had a higher raptor diversity index than the metropolitan. A T-test analysis showed that there are significant differences in raptor diversities between urban forests and the metropolitan. The study also revealed that there are significant differences in raptor abundances between forests and the metropolitan of the greater Nairobi region. The study revealed that species numbers peaked during the long rains across the months of March, April and May. The results showed that most of the nests (81.3%) were found in exotic trees with only 18.7% found in indigenous trees. Ngong Road Forest had the highest

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nests density; with Thogoto Forest having the lowest. We hope that this study will provide the baseline towards developing a conservation strategy to safeguard Nairobi's high raptor diversity.

An Examination of Extra-pair Paternity Frequency in a Suburban Red-shouldered Hawk Population

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In the last 20 yrs, the evolution of genetic techniques has brought new insight into avian mating systems, revealing that while most bird species are socially monogamous, the majority of these populations have instances of extra-pair fertilization. Most focus has been on the examining extra-pair paternity (EPP) rates in passerine species (>200 publications), and only a handful examining EPP in raptor species (<30 publications). Considering the high reproductive investment of the social male, and the cost to the female of losing this benefit by soliciting copulations outside the social pair bond, it would be expected that most raptor populations would exhibit low to no occurrence of EPP. This holds true for the majority of these studies, but not all – such as with Rosenfield et al's 2015 report of high EPP frequency in an urban population of Cooper's Hawks (*Accipiter cooperii*). It is unclear, however, if the unique conditions presented in a human-dominated landscape are a contributing factor. Closer examination of other raptor populations occupying such habitat may help provide insight into the driving mechanisms behind this mating strategy. Preliminary work has been conducted to examine if EPP occurs in the Red-shouldered Hawk (*Buteo lineatus*) population in the suburban area of Cincinnati, with breeding age individuals trapped, color banded, and sampled just prior to and during the breeding season between December 2017 and July 2018. Initial observations suggest that conditions may be present that might promote the occurrence of extra pair copulation, with birds previously banded in a known territory later observed or re-trapped while attending a nest in a different territory. Laboratory analysis of the blood samples collected from these individuals, as well as samples collected from the broods attended to by these individuals, could reveal whether or not EPP occurs in this population.

Geo-spatial Analysis of Size of Breeding Territory of Vultures in the Indo-Gangatic Plain to the Vindhya Range of Bundelkhand Region, India

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Territoriality influences the survival of adults and or young, or increase the success rate of hatching/fledgling. Our aim was to determine territory size for these species, evaluating spatial variations in parameters of the territories between the non-reproductive and reproductive seasons. This study was conducted from the 2016 – 2017, and focused on population size in the Bundelkhand Region of Madhya Pradesh India. Territories in protected areas include Madhav national Park (n = 6) and Panna National Park (n = 9), and non-protected territories in Shipuri (n = 8), Lalitpur (n = 4), and Tikamgarh (n = 6). The Lincoln-Peterson model/Multiple observers method with two independent observers was used for avian point counts. The time of the detection of individual birds was also recoded with the time depletion and removal method. A territory may be vigorously defended or loosely guarded depending on the abundance of the resources. Breeding territories contained 660 adults (mean = 13.20 ± 14.95), 286 immature (mean = 5.61 ± 6.46), and non-breeding territories contained 635 individuals (mean = 12.21 ± 13.95). Territories were observed linearly all are along the water body on the cliff at the height of (30-35 m), circular on the monument (20-25 m), and scattered on trees (25-30 m). The size of vulture population was not static and fluctuated, with the territorial population changed year after year dependent on resources , abundance of predators, and environmental factors. The three major threats to Vulture populations were habitat conversion, power lines, and shrinkage of breeding territory due to mining. Today the Ken-betwa link project and the National Mineral Development Corporation (NMDC), a producer of diamond of India from its Majhgawan mine at Panna, is the biggest threat to the breeding territories of Vultures in Panna National Park.

POSTER SESSION II



Amur Falcon | Photo by André Botha

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Barn Owls and Stress and Sex in the Fraser Valley, BC, Canada

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Corticosterone is a main glucocorticoid, involved in regulation of energy, immune reactions, and stress responses. It is necessary for survival but chronically elevated levels can reflect ongoing stressors beyond typical daily activities for birds. It can also vary with age and sex in birds. In Barn Owls (*Tyto alba*), we examined the corticosterone concentrations in down feathers of chicks from 30 nests in the Fraser Valley, British Columbia, Canada to examine variation in corticosterone among chicks in nests in agricultural locations where birds may be exposed to variations in food availability, rodenticides and insecticides. We also examine the variation between male and female chicks to determine if corticosterone levels vary consistently based on gender versus body mass. Similarly, by determining sex through PCR we will determine if the morphology, mass and size of chicks is predictive of their sex when they are banded.

Big Data from Telemetry Studies of Raptors: A Case Study of Golden Eagles in Western North America

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As the number of raptors tracked by satellite telemetry increases rapidly, we must refine robust and defensible approaches to interpreting the resulting thousands to millions of telemetry fixes. Here we illustrate one approach that the U.S. Fish and Wildlife Service has adopted to draw inference from location data drawn from over 800 Golden Eagles (*Aquila chrysaetos*) fitted with satellite PTTs. Our ultimate goal is to provide spatial products that reduce possible conflict between conservation of

Golden Eagle populations and land uses that may impact eagles, such as utility-scale energy development, via targeted habitat management and mitigation strategies. Because our primary focus here was predicting relative intensity of space use by eagles at a continent-wide scale, during particular seasons and behavioral modes, we first used Bayesian state-space movement models to classify portions of eagle satellite tracks into either sedentary or transiting (rapid, directed movements that occur during migration, dispersal, or commuting across home ranges) behaviors. We then used the movement-classified telemetry fixes as input to Maxent models that sought to project space use across the entire western portion of the eagle's range in North America. We found that careful selection of covariates, temporal- and individual-based thinning, and specifying the area available for modeling based on the eagles' characteristic movement patterns (i.e. 20 km windows when sedentary, 50 km when transiting) greatly improved our models. We also note that in some cases, such as for sedentary Golden Eagles in the winter, a single range-wide model performed adequately, whereas in other cases, space use was best modeled using separate models for ecoregions within the overall range. Our final models were then important components of preliminary range-wide risk assessments, when combined with spatially explicit models of breeding habitat and possible threats.

Mortality in GPS-tracked European Honey Buzzards (*Pernis apivorus*)

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In addition to monitoring reproductive performance, mortality estimation is a central aspect of every population study. However, in unobtrusive and/or highly mobile species traditional methods, such as mark-recapture, may not be a real alternative for collecting relevant data. In such species, information collected from GPS-tracking constitutes an alternative. The European Honey Buzzard (*Pernis apivorus*) is a declining migratory Palearctic forest raptor that winters in the rain forests of Africa. As part of a population study on European Honey Buzzards in Finland, 38 birds (nine breeding adults and 29 juveniles) were equipped with GPS-trackers during 2011 – 2016. As expected, adult birds had a much lower annual mortality than young birds. In absolute terms, most deaths occurred while the birds were on the African wintering grounds. However when the two age categories were analyzed separately, mortality was more common during migration for young birds, especially during spring

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** **William C. Andersen Memorial Award Candidate**

migration. Most mortality events were due to predation and exhaustion, but close to one fifth of all deaths were related to human activity. In a slowly reproducing specie like the European Honey Buzzard, human caused mortality could be a major reason for why the species is in decline in much of its range.

The Impact of Wind Energy in the Verraux’s Eagle (*Aquila verreauxii*) in South Africa: A Case Study and Overall Perspective

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We satellite track a female eagle covering the pre-cons (2014-15), construction (2016-17) and operational (2018) phases of a wind farm in the Northern Cape, to compare the variations home range in similar time periods. KDE and MCP polygons have not globally varied from 2014 to 2018 for the considered wind farm development phases. Works in the area during 2016-2017 did not change behavior during roosting, mating, incubation, laying or chick rearing, but some avoidance of the footprint existed during fledgling. The monthly movement patterns remain the same with maximums around May and minimums during June. Variations during construction time could be related with the daily working schedule on site. Mean distance travelled between locations changed a little from pre to construction but also within each yr. We did not account for other habitat changes (e.g. prey availability) or other potential influences. Despite observed changes during wind farm construction Verraux’s Eagles showed flexibility to buffer the changes in the landscape features, and bred successfully since 2014. Pre-construction mitigation decisions such as removing some turbines helped to avoid the more sensitive areas of the project. We finally have developed a protocol for monitoring Eagles at wind farms. Secondly, we have overlapped the distribution of the species by the SABAP2 (pentads) with wind energy projects developments in South Africa. Eastern and Western Cape provinces are the most potentially impacted provinces, with a 7.28% overlap each. Over 22 yrs, five Verreaux’s Eagles have been killed by turbines since 2013 compared to 80 dead through other causes all over the country, such as electrocution and collision with power lines, but found by non-systematic searches as the case of wind energy monitoring. It is important to prioritize conservation threats and also establish a clear Conservation Plan for the species.

Canadian Peregrine Falcon Monitoring Supports Achievement of Conservation Milestone

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Peregrine Falcon (*Falco peregrinus*, subspecies *anatum/tundrius*) was reclassified from “special concern” to “not at risk” in November 2017 by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The decision represents the culmination of a substantial recovery effort that began in the 1970s, and was based primarily on the results of the unpublished national Peregrine Falcon surveys undertaken in 2010 and 2015, which documented ongoing population increases across most of southern Canada, particularly Ontario and Quebec. The 2010 survey was the last of the quinquennial surveys to have coverage throughout the country. In southern Canada, there were 296 known nesting territories in 2010, more than double the count in 2000. Although the count dropped slightly to 292 in 2015, this was largely a function of Ontario not conducting a comprehensive survey. The number of mature Peregrine Falcons in southern Canada is estimated around 1000, factoring in survey coverage and the presence of non-breeding individuals. Estimates of population growth in southern Canada over the most recent 20 yr period range from +50% in Saskatchewan to more than +3000% in Ontario. Population monitoring in northern Canada has focused on repeated sampling of selected areas. Although trends vary somewhat by region, they have generally also continued to increase overall, but at a slower rate than in southern Canada, and low productivity remains a concern in some areas. The number of mature Peregrine Falcons in northern Canada is estimated to be at least 35,000. The pealei subspecies was also reviewed by COSEWIC. Despite a continuing increase in numbers, there are likely fewer than 1000 mature pealei individuals in Canada, and the subspecies maintained the classification of “special concern” based on the small population and the potential for oil spills or other factors to reduce the seabird populations that are its primary prey.

Raptor Population Trends in Northern Botswana: A Re-survey of Road Transects After 20 Years

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Across Africa, many raptor species, especially Vultures, are in steep decline. Botswana is regionally important for numerous raptor species including Vultures, but recent population trends of raptors within this country are totally unknown. In 2015 – 2016 we repeated road transects for raptors across northern Botswana that were first conducted in 1991 – 1995. In total, we re-surveyed 20,712 km of transects. From these data we explored changes in abundance of 29 species. Fourteen species (48%) showed significant declines. Of these, 11 species declined by >50% and three species declined by 37-50%. Non-significant declines of >70% were shown for four species, of 30-65% for six species and of <10% for a further two species. In contrast, only three species, all large eagles – Tawny Eagle (*Aquila rapax*), Brown Snake Eagle (*Circaetus cinereus*) and Black-chested Snake Eagle (*Circaetus pectoralis*), showed significant but small increases of between 6-15%. For most species, population trends were similar both inside and outside of protected areas, with only two species showing significantly different trends. Declines of Bateleur Eagle (*Terathopius ecaudatus*) were lower inside protected areas than outside of them. In contrast, Brown Snake Eagles showed stable populations inside protected areas but large increases outside of protected areas. These re-surveys suggest extremely worrying trends for multiple raptor species in Botswana, and highlights the benefit of repeating historical surveys to understand population trends in countries that lack systematic monitoring of wildlife populations.

The Roles of Nest Attendants at Harris’s Hawk Nests (*Parabuteo unicinctus*) in Southern Texas

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In south Texas, more than half the breeding groups of Harris’s Hawks include at least one auxiliary in addition to a breeding pair. Here, we explore the behavioral roles of individual group members based on footage from cameras employed at five nests during the 2018 breeding season. Detailed ethograms for each nest were developed to determine which individuals visit the nest and what behaviors they exhibit. Of the five nests, two nests had

at least two auxiliaries (both nests include one juvenile auxiliary), two nests had at least one adult auxiliary, and one nests had no auxiliaries. At all five nests the breeding female was the most frequent visitor to the nests (70% of all visits, n = 220), spent the most time feeding chicks (89% of feeding bouts, n = 140), and made the majority of the prey deliveries (56% of total prey deliveries, n = 143). Only 3% of all visits to the nest were by auxiliary group members, but at a single nest an adult male helper provided 12% of the prey items delivered compared to the dominant male who delivered 15% of the prey items. No auxiliary was documented engaging in brooding behaviors (feeding chicks, providing shade, modifying or supplying nesting materials). We suggest that in south Texas Harris’s Hawks’ nests are primarily attended by the breeding female, with appreciable support from the dominant male (likely her mate) during the nesting phase, although these results are based on a single breeding season and may not characterize the population long term. Auxiliaries could also provide other benefits such as nest/territory defense, providing prey to fledglings, or by enhancing the effectiveness of group cooperative hunting.

Temporal Changes in the Diet Composition of the Eastern Imperial Eagle in Hungary

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The diet composition of breeding Eastern Imperial Eagles (*Aquila heliaca*) was analysed in Hungary between 2005 and 2017, and compared with two previously published datasets from the periods of 1982–1991 and 1992–2004. Altogether the distribution of 8543 prey items of 126 different species and 29 other taxa were analysed within a 36 yr period. We found that the previously abundant Common Hamster (*Cricetus cricetus*) became marginal (7.42%), while European Sousek (*Spermophilus citellus*) practically disappeared (0.03%) from the diet of Imperial Eagles. Small game species, like the Brown Hare (*Lepus europaeus*) and the Common Pheasant (*Phasianus colchicus*) composed a remarkable part of the diet (28.11% and 11.22% respectively), which raised some conflicts with hunters regionally and probably also contributed to the high prevalence of persecution incidents against the eagles. In parallel with the loss of traditional prey species, corvids (13.10%), pigeons (8.90%), waterbirds (6.83%), other rodents (6.71%), Roe Deers (*Capreolus capreolus*) (5.59%),

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raptors and owls (4.88%) became regularly detected prey species. The temporal changes of the main prey categories were analysed between 1998 and 2017, when the ratio of Hamster and Pheasant showed significant decrease (-27.29% and -6.38%, respectively). The ratio of Brown Hare also showed slight decrease (-3.98%), but the change was not significant. On the other hand, the ratio of corvids, waterbirds and Roe Deers (*Capreolus capreolus*) within the diet showed significant increase (+18.20%, +6.25% and +5.39%, respectively). The observed flexibility in the foraging behaviour of Imperial Eagles greatly facilitate conservation efforts, as they proved to be able to utilize the most abundant prey sources, i.e. they were not depending solely from the status of any single specific prey source. However, eagles could only shift and survive in those regions, where their traditional preys decreased, if alternative species were available for them.

Why Defecate on Your Doorstep? Investigating an Unusual Behaviour in Africa's Smallest Falcon

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Depositing feces at the nest should be expected to carry risks such as increased parasite load and disease exposure. This perplexing behaviour is unusual in birds but is consistently shown in a handful of species, and has been demonstrated to function in predator deterrence, thermoregulation, and prey attraction. Pygmy Falcons (*Polihierax semitorquatus*), which occupy the massive, communal nests of Sociable Weavers (*Philetairus socius*), consistently defecate at the entrance of their nest chambers, creating a conspicuous "doormat" of white fecal matter. We addressed two potential adaptive hypotheses, proposing that antibacterial and/or antifungal functions in Pygmy Falcon feces may explain this behaviour, such that fecal mats could reduce bacterial and/or fungal loads within the nest. Fresh and dry organic fecal extracts were tested, using the disc diffusion method, against *Staphylococcus aureus* and two of numerous mold species cultivated from samples collected in

situ. We found no evidence for antibacterial or antifungal effects of Pygmy Falcons feces against these test organisms. Further investigation into alternative hypotheses such as boosting the immune system, anti-parasitic properties, thermoregulation, conspecific signaling, and/or predator deterrence are required to shed further light on this unusual behaviour.

Natural-nests versus Nest-boxes: Differences in Reproductive Parameters and Body Condition in American Kestrel (*Falco sparverius*) in Argentina

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Reproduction is the most important process in the life of any given species as it allows the persistence of populations. Usually, reproduction is determined by several factors but with a great influence of environmental factors. The American Kestrel is an obligate cavity-nester. Nest site selection in cavity nesters should be influenced by the quality of the cavities as this quality can determinate breeding output. Here we compare reproductive parameters, and physical condition of fledgling and adult American kestrels from natural-nests (n = 45) and nest-boxes (n = 16). We sampled over two breeding seasons 2016/17 and 2017/18 in semi-arid forests in La Pampa, central Argentina. Reproductive success varied significantly among nest-types ($X^2 = 6.8959$, $P = 0.0086$, $df = 1$), and was lower in natural-nest (31,1%) compared to nest-boxes (68,7%). The number of fledglings produced was also lower in natural-nest than in nest-boxes ($X^2 = 39.153$, $P = <0.001$, $df = 1$). On the other hand, body condition was higher in females than in males for both fledglings ($X^2 = 5.5473$, $P = 0.018$, $df = 1$) and adults ($X^2 = 16.306$, $P = <0.001$, $df = 1$) but there was no effect of the type of nest. Our results suggest that breeding performance of American Kestrels in our study area is lower when using natural nests than when using nest-boxes. Probably, nest-boxes provide a better cavity for kestrels while natural nests are more prone to be impacted by weather or assaulted by predators. External factors such as climate, competition, and predation may play a key role in the low success obtained from the natural nest sites

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included in this research.

Influence of Mining Activity in Heavy Metals Levels in Feathers of an Avian Scavenger from Atacama Desert (Chile)

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Heavy metals are ubiquitous pollutants in the environment that cause several harmful effects both in wildlife and humans. In this study we used primary feathers from a local and widely spread scavenger bird, the Turkey Vulture (*Cathartes aura*) to evaluate the pollution by Cd, Pb, Cu and Zn in four areas distributed in Atacama and Coquimbo Regions, northern Chile. Both regions represent the highest levels of mining exploitation in the country, which generates predictably high levels of environmental contaminants. The four metals were found in all the analyzed samples (n = 44) and statistical differences were shown between regions. Mean concentrations in Atacama Region were Cd 0,65 ± 0,63 mg/kg d.w.; Pb 3,31 ± 2,53 mg/kg d.w.; Cu 87,81 ± 75,03 mg/kg d.w.; and Zn 202,77 ± 101,13 mg/kg d.w.; while mean concentrations in Coquimbo Region were Cd 0,69 ± 0,67 mg/kg d.w.; Pb 1,67 ± 0,79 mg/kg d.w.; Cu 18,41 ± 5,96 mg/kg d.w.; and Zn 149,00 ± 105,73 mg/kg d.w. According to literature, these values can be considered very high for Cd, Pb and Cu, and normal for Zn in both Regions being compatible with heavily contaminated areas. Besides, in some cases, the Cd and Pb concentrations detected could be responsible for toxic effects in birds. In spite of this, the differences found between the two regions in favor of the Atacama Region reinforce the idea of the strong influence of the nearby mining settlements, more important in this region, even though other factors should be studied.

Assessing Risk and Prioritizing Remedial Work to Reduce Electrocutation of Egyptian Vultures (*Neophron percnopterus*) in Oman

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Reduction of electrocution threat is important to conserving Egyptian vultures and other soaring birds, some of which are endangered. Using GPS tracking data from four non-adult Egyptian vultures, we assessed their relative risk of electrocution in relation to dumpsites in Oman, and thereby estimated the affect making infrastructure safe near dumpsites would have on electrocution. Combined 95% kernel home range of vultures encompassed 10562 km², which held 3732 km of 11 and 33 kV power lines. Of vulture GPS locations, 10.1% of 11 and 33 kV powerlines, and 42.7% were within 5 km of dumpsites, suggesting that activities aimed at reducing electrocution risk in those areas would have disproportional benefit. The likely cost and cost-effectiveness of different approaches to making electricity infrastructure safe are discussed. Being able to prioritize areas for actions that reduce electrocution threat can increase cost effectiveness, and make it more likely that electricity companies will consider remedial and planning actions to reduce the threat, especially if those actions can also benefit customers and reduce maintenance costs.

The BUBO Database: A Tool to Update Raptor Distribution in Bolivia

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The limited availability of information on birds of prey in Bolivia reflects the challenges to study this group of birds, for which even basic information, such as distribution, can be scarce. A rapid collection and processing of large-scale raptor distribution data (for a whole country for example) would seem unfeasible; however, the concept of citizen science has the potential to help in this task. In order to initiate a systematic updating of raptor distribution data in Bolivia, and to evaluate the potential of raptors as a conservation tool, different social groups are being trained in the identification and monitoring of raptors as part of the of citizen science project BUBO (Base Unificada de las aves rapaces de Bolivia). A central database was created based on an exhaustive review of published and unpublished raptor records in Bolivia, and data entry and collation continues. Currently the database has 35.186 raptor records; 1% (262) already comes from citizens' observations after seven mos of the project implementation. The recruitment of participants is simple, not so the maintenance of a constant level of participation. The supply of equipment helps to motivate the participants and this type of incentives should be routine as the project goes on. The uncomplicated protocols of the project allow its adaptation

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to different contexts, facilitating its progressive implementation nationwide and motivating to explore the possibility of collaborating internationally. This experience shows that a citizen science approach is a useful alternative to promote raptor research in places where it still receives little attention, as it is the case of Bolivia. To optimize its reach and impact, this project will be strengthened by improving the processes and methods it uses for data entry and analysis, increasing the collaboration among researchers, authorities and institutions, and most importantly, increasing the number of participants.

Black Hawk-Eagle (*Spizaetus tyrannus*) in Urban Areas: Density and Habitat Use

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The Black-Hawk-Eagle is a large raptor of neotropical forests. This species is often recorded flying over the urban forests of Campo Grande, a medium-sized city located in the western region of Brazil. The objective of this study was to estimate the population size and habitat use of the Black-Hawk-Eagle in the urban area of the city, and to obtain information about its ecology and behavior in this area. Observation points were carried out in three forests of the city, with sampling between January 2017 and June 2018. In addition, photographs available on collaborative platforms (“citizen science”) obtained in the municipality were analyzed. We collected more than 40 records; in the collaborative platforms, we took more than 50 photographs of the species of the city. We found that all records of the species are obtained in five locations in the city, ranging in size from 30 to 250 hectares. Based on the patterns of feathers, we identified two different adult individuals who form a breeding pair. Raptors move between fragments of the city, often overflying the urban matrix. Among the prey we identified small birds, skunks, and other small vertebrates. Analyzing the photographs, we found photos of young raptors over four different periods between 2011 and 2018, indicating that at least three different nestlings hatched in the urban area.

Debshan Ranch, Shangani - A New Nesting Haven for White-backed Vultures

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The study’s aim is to understand the use of private ranches for breeding by Southern African vultures, particularly the critically endangered White-backed Vulture (*Gyps africanus*). This is important as private land in Zimbabwe underwent rapid land-use change and fragmentation with the fast-tracked land resettlement program in the yr 2000. Measured parameters include preferred nesting niche and nesting productivity on Debshan Ranch, Shangani. Results over four yrs in this on-going study show that Debshan Ranch supports about 25 nesting pairs of White-backed Vulture in successive breeding seasons, pointing to the importance of the ranch in the ecology of the species. Prior to 2014 when a vulture restaurant was re-established on the ranch, White-backed Vultures were not known to nest on the Ranch, though three species (Cape Griffon Vulture (*Gyps coprotheres*), White-backed Vulture, and Lappet-faced Vulture (*Torgos tracheliotos*) were commonly sighted there.

Who Scavenges Raptor Carcasses?: The Case of the Eurasian Eagle Owl (*Bubo bubo*) in Spain

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The study of how raptor carcasses disappear has often been overlooked. This knowledge is important not only for the basic ecology of ecosystems but also because it can have important applications in raptor conservation, such as to estimate mortality rates around human infrastructures. In this work we studied which species fed on Eurasian Eagle Owl carcasses, and what was the time of disappearance. For this we compared 19 Eagle Owl carcasses with a similar number of Hen (*Gallus gallus*) carcasses in four areas of Spain. Only six out of 19 Eagle Owls were consumed completely compared to 17 out of 19 Hens. Only

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two species of scavenger consumed the Eagle Owl carcasses, Wildboar (*Sus scrofa*) and Red Fox (*Vulpes vulpes*), while a total of 7 different species were detected to have fed on hen carcasses. Moreover the time of disappearance was four times higher in Eagle Owls than in Hens. We observed the Eagle Owl carcasses generated fear and intimidation on the majority of potential scavenger species. This behavior could be related to a greater predation pressure of the Eagle Owl on some facultative scavengers in certain areas such as Red Fox. Our results seem to indicate that the disappearance rates of raptor carcasses could be overestimated due to general non-raptor carcasses have been used to calculate them.

Breeding State Determinants of the Endangered Mountain Hawk-Eagle Revealed by a Dynamic Multi-state Occupancy Model

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The breeding-site occupancy and breeding success (i.e. breeding-state) of the Mountain Hawk-eagle (*Nisaetus nipalensis*) was investigated at 90 sites from 2002 to 2017 in the Kaga district, Ishikawa, Japan. The determinants of the breeding-state were analyzed using a dynamic multi-state occupancy model. Consequently, the occupancy probability was positively correlated with deciduous broad-leaved forest cover and the slope SD (indicating terrain ruggedness), and negatively correlated with evergreen broad-leaved forest cover. A nonlinear (squared) effect was observed for slope area of 30 degrees or more and the evergreen coniferous forest cover, and the occupancy probability was maximum when these values were about 0.3, respectively. The successful breeding probability was positively correlated with slope SD and negatively correlated with previous yr breeding-state. Most of the deciduous broad-leaved forests in the study area are primary forests, which tend to have high biodiversity. It has been suggested that deciduous broad-leaved forests are important habitats that support breeding Hawk-eagles. Contrarily, as the evergreen broad-leaved forests possess leaves throughout the year, it is difficult for the Hawk-eagle to spot the prey in the forest, rendering it unsuitable as

a foraging-site. Our results suggest that evergreen coniferous forest is an important nesting habitat for the Hawk-eagle, because the individuals in the surveyed area frequently use evergreen coniferous trees as a nest-tree. Places with steep slopes and rugged terrain create favorable wind conditions for the flight of the Hawk-eagle and as well as their foraging strategies. The slope SD was positively correlated with the breeding success of the Hawk-eagle as well as the occupancy probability. This can be explained by the same reason as stated above. In addition, the breeding success of the Hawk-eagle was negatively correlated with the breeding-state of the previous year. This reflects the breeding cycle of this species, i.e., many Hawk-eagles lay eggs biennially.

Seasonal Ranges and Movement Variation Between Siblings and Age Classes in Juvenile Bald Eagles (*Haliaeetus leucocephalus*)

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Movement strategies of pre-adults have major consequences to individual fitness while they search for critical resources and avoid risks to survival. Despite being heavily studied, little is known about the movement of many immature Bald Eagle populations; particularly regarding the differences between siblings and age class. To better understand juvenile movement, we fitted 36 eagle nestlings from southern Ontario and interior New York with ARGOS platform transmitting terminals. Maximum annual movements varied between 160-1975 km, which we classified as short distance (650 km) movement strategies. We used both 50% and 95% Brownian Bridge Movement Models to measure utilization ranges. Mean wintering ranges were larger than summering ranges at both 50% (Winter = 841 km; Summer = 425 km) and 95% (Winter = 8327 km; Summer = 6016 km) spatial scales. We assessed five sibling pairs by comparing their range overlap, distance travelled, and directionality. We used GLMMs to test whether ranges and distances travelled varied between season, sex, age groups, and movement strategy. The northern shore of Lake Erie and the Catskills Mountains were highly occupied areas. Although Bald Eagle siblings moved independently of one another, 80% of sibling pairs showed similar movement strategies. We show that eagle movement does not significantly differ between sexes, however there were significant differences between age groups, seasons, and strategies. Finally, our tracked eagles show a strong tendency to move on a North-South axis, a pattern consistent with Bald

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Eagles across North America.

Breeding and Individual Performance of American Kestrels (*Falco Sparverius*) in a Gradient of Agriculture Intensification in Central Argentina

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Agriculture expansion and intensification is one of the main drivers of global change. Given their ecological characteristics and role as top predators, raptors could be particularly sensitive to these changes. Here we examine possible consequences of intensified agriculture and rainfall on breeding individual performance (body condition, pro-inflammatory response, plasma cholinesterase activity) in free- living American Kestrels breeding in nest boxes in a gradient from intensified agricultural lands to traditional farming lands to natural forests in central Argentina. Only breeding success varied among sampling areas, being higher in traditional farmlands with no differences between intensive farmland and natural forest. Breeding parameters were not directly reduced in boxes surrounded by more intensive agriculture, however, the positive effect of pastures on kestrels breeding success, in the context of a regional transformation of pastureland to soybean production suggest that a regional reduction in breeding performance may be occurring for this species. Rainfall had a positive effect on breeding performance except during the chick rearing when it increased nesting failure. Nestling body condition and pro-inflammatory capacity showed variation related to factors operating within nests more than with exposure to more intensive areas. In addition, no differences were found in plasma cholinesterase levels between sampling sites and there were many Kestrels with the lowest measurable cholinesterase activity levels. This may be because there is no marked exposure to cholinesterase inhibitor pesticides during the breeding period or may be the result of a low capacity of the method we used. Our results indicate that agroecosystems can provide suitable habitat for raptors with available food and breeding resources. However, it is expected that the continuous expansion of agriculture intensification negatively affects demography and we encouraging further study to evaluate how land uses can operate also on health of free living birds.

Fine-Scale Assessment of Habitat Use by Territorial Bearded Vultures (*Gypaetus barbatus*) In Pyrenees,Spain

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Fine scale mapping of home range use may be very useful to refine estimates of carrying capacities, facilitate understanding of species' resource requirements, or assess and predict impacts of human activities. The Bearded Vulture is a threatened species in the Western Palearctic. During the last century its spatial distribution has been greatly reduced. Nevertheless, several ongoing reintroduction projects are underway in certain subpopulations (i.e. Alps, Andalusia). The largest natural European population of bearded vultures is confined to the Pyrenees (n = 130 breeding units, 61% of the European population in 2015). Improving the knowledge of the habitat use of this species will help improve management actions aimed at increasing the distribution of this species and minimizing the risk of meta-population extinction. The aims of this study are to assess the fine-scale habitat use by territorial Bearded Vultures in Pyrenees using two home range estimation methodologies and to identify potential infrastructure risk areas. A total of 10 territorial Bearded vultures were tracked in the period 2006-2017 in Pyrenees, located in the border area between France and Spain. We tracked using solar-powered 70 g Argos satellite transmitters (PTT/GPS). Territorial Bearded Vultures were tracked during a mean of 3.4 ± 2.5 yrs. The vultures used mixed habitats of forest forests and pasture areas with low levels of human development. Power lines are the main infrastructure detected inside high used areas. The identification of high use habitats by this vulture is an important step in the conservation of the species and will improve management strategies.

Home Range Size and Habitat Use of Adult Saker Falcon (*Falco cherrug*) in the Breeding Season in Hungary

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The global population of Saker Falcon decreased significantly in the past decades resulting in Endangered IUCN status. There are multiple reasons for decline, including direct negative factors – like illegal trapping and electrocution.. Other, indirect causes

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** **William C. Andersen Memorial Award Candidate**

are more difficult to elucidate. Satellite tracking enabled us to estimate the home range of adult birds and compare the results from various aspects to explore other factors for decline. For this research, we focused on the breeding period and we compared the home range size of breeding (successful) and non-breeding (no mate or failed breeding attempt) adults, breeding adults in various parts in Hungary and we also compared home range sizes of same adults in subsequent yrs to understand possible factors impacting the population. In three subsequent European Union supported LIFE Nature projects, we tagged 42 adult Saker Falcons since 2008 (male = 34, female = 8), out of which data of 29 (tagged with GPS-GSM, GPS-GSM-UHF or GPS-UHF loggers) were detailed enough for the study. Results showed difference of home range size of breeding and non-breeding adults, as well as between home range sizes of Saker Falcons breeding in various parts of Hungary. Home range sizes of same individuals in subsequent breeding seasons varied presumably according to prey availability affected by weather conditions and human land use (agricultural practices in subsequent years in the same area). Home range sizes varied within the same breeding period, restraining birds near the nest in the most sensitive periods (hatching and fledging). Results of tracking also showed that Saker Falcons were willing to travel even twice as far as 25 km per day for a reliable and good quality food source (e.g. a large colony of European Ground Squirrel (*Spermophilus citellus*)).

Citizen-Science Utility in Monitoring of Raptors in Northern Ireland

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The Northern Ireland Raptor Study Group (NIRSG) is an organisation formed in the 1990s to monitor birds of prey in Northern Ireland and its border counties. The NIRSG has a small network (~150) of expert volunteers. Since 2008 the group has been working in partnership with the Northern Ireland Environment Agency (NIEA) with funding for the centralised co-ordination of monitoring data, reporting and analysis. These resources have facilitated an extensive programme of training of volunteers, workshops, conferences and reports. The up-skilling, resource provision and support of the specialist surveyors is key to data collection and standardisation. The data generated has resulted in between 600 – 1,400 raptor breeding and wintering sighting records each year, along with 400 – 600 nest records annually. More than 4,100 records have been collated across a range of species with most records aggregated for Peregrine

Falcons (*Falco peregrinus*) (n = 1,745; 2008–2017), Hen Harrier (*Circus cyaneus*) (n = 805; 2008–2017) and Buzzard (*Buteo* sp.) (n = 540; 2008–2017). Historical records (prior to 2008) have been collated, adding an additional 6,000 records to the centralised raptor database. The utility of such data is high and centralised resources are able to carry out more formal analysis, e.g. for peer-reviewed publication, strategic and framework analysis, and directly inform conservation and/or management action such as nest protection and strategic spatial planning. The feedback and annual reporting to the raptor network is key to encouraging the volunteer resources and adding value to nest monitoring, wintering monitoring and sightings data to get scientifically robust information on distribution, occupancy, productivity, threats, and provide direct conservation, protection and analysis. The key to this is citizen-science with an expert and trained raptor network but it is essential to have a formal and centralised staff resource to maintain and support the raptor monitoring scheme.

Restoration of the Red Kite (*Milvus milvus*) in Ireland

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Historical and archaeological evidence indicates that the Red Kite (was present in Ireland until its extinction in the mid-eighteenth century, most likely as a result of persecution and deforestation. The Red Kite was absent from Ireland as a breeding bird for over 200 yrs, and although nest building was recorded in County Antrim in 2002, it was considered that the species would not naturally re-colonize Ireland in the near future. In 2007 the Golden Eagle Trust and Welsh Kite Trust embarking on a large-scale re-introduction project, which has seen the Red Kite successfully return to Ireland, and a similar project with the Royal Society for the Protection of Birds (RSPB) reintroduced Kites to Northern Ireland (NI). The project teams extensively reviewed the suitability of habitat, prey and presence of indicator species i.e. Buzzard (*Buteo buteo*) and Raven (*Corvus corax*) in advance of the reintroduction. Over the subsequent five yrs (2007-2011), 160 young Red Kites were removed from nests in Wales and translocated to sites in Ireland within county Wicklow (2007-2011; 120 birds), Dublin (2011; 40 birds), and in NI in county Down (2008-2010; 80 birds). The young birds were held in aviaries until 9-10 wks of age. A combination of radio and satellite tracking, patagial wing-tagging, and nest monitoring has allowed an insight into the birds' movements, population

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dynamics, productivity, diet, and behavior, More than 80 pairs of Kites are now recorded in Ireland which produced more than 60 young in both 2017 and 2018. More than 320 young Kites have also now fledged from Irish Kite nests. When combined with the RSPB restoration programme it means that more than 100 pairs of Kites are now established across the island of Ireland.

Artificial Night Lighting Determines Nest-site Selection and Habitat Use by Burrowing Owls in Urban Environments

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Light pollution caused by artificial lights in urban areas can potentially affect wildlife. In this study we examine the effects of artificial night time lights on habitat use and nest-site selection of a nocturnal avian predator, the Burrowing Owl (*Athene cunicularia*), in an urban environment. Fifteen Owls were tagged with GPS data loggers that recorded individual's locations every one minute for 4-6 days from bird tagging to recapture. Habitat characteristics, including nest-site habitat structure and distances from nests to the nearest artificial lights, houses, and roads were recorded for 27 active Owl nests and for 39 randomly-selected locations within the study area. In addition, insects prey availability was assessed behind ten artificial lights and in ten control sites without lights by setting pit-fall traps. Distance to the nearest artificial light was the single variable explaining nest-site selection by Owls. Owls' nests were located significantly closer to artificial light than expected by chance. Furthermore, GPS individual's locations during the night were clustered in areas around artificial lights, while during the day Owls were closer to their nests. Our results show that artificial night lighting may be a determining factor in both habitat use and nest-site selection by the Burrowing Owl in urban environments. Burrowing Owls apparently thrive in many cities across the Neotropics although reasons of such success in these human-made environments are still unknown. Artificial lights could be either playing a key role on the colonization process of urban habitats by Burrowing Owls or providing foraging advantages to those Owls that have been able to get into the cities and succeed in these novel environments.

Changes in the Home Range Size of Breeding and Nonbreeding Red-tailed Hawks (*Buteo jamaicensis*) throughout the Breeding Season

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Breeding home ranges of raptor species are known to be smaller than their year-round territory, likely due to the centralized nest location that they consistently return to for nesting duties. Unknown however, is how breeding home range size fluctuates throughout the season. As perch hunters, Red-tailed Hawks have been known to deplete their prey source by overhunting from preferred perches. It is likely that hunting close to their nest would similarly deplete their prey resources, particularly as their growing young demand additional resources. We expect, therefore, that breeding individuals expand their hunting territory as the season progresses. Conversely, we expect that nonbreeding individuals, whether a juvenile or an adult lacking a mate or territory, would be able to decrease their home range size as they acquire preferred perches and roost sites, and as the small mammal breeding season provides superfluous resources. These seasonal changes in home range size can be determined with data collected from breeding and nonbreeding Red-tailed Hawks fitted with GPS transmitters from 2016-2018. We can then determined home range size during the pre-nesting, early nesting, late nesting, and fledgling stages of the breeding season. The fine resolution data acquired from GPS transmitters can reveal otherwise unattainable information about the space-use of breeding and nonbreeding Red-tailed Hawks.

Time-of-Day Effects Reassessed with Roadside Raptor Surveys and Red-Tailed Hawk (*Buteo jamaicensis*) GPS Transmitter Data

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Time-of-day effects is the concept that roadside raptor surveys conducted at different times of day will result in different raptor

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compositions and behaviors. Here, we integrated the use of roadside raptor surveys and GPS transmitter data from Red-tailed Hawks to ascertain the accuracy of time-of-day effects and further enhance our knowledge of how time of day influences Red-tailed Hawk locations and behavior. Our raptor surveys found no difference in raptor composition between morning and afternoon surveys, though evening surveys did report a significantly higher number of Red-tailed Hawk sightings. This corresponded with the finding that our transmitter-tracked Red-tailed Hawks employed fast flight most often in the evenings, which may suggest that increased activity in the evenings may make Red-tailed Hawks more conspicuous. Alternatively, a greater number of Red-tailed Hawk sightings and use of flight could suggest a greater risk of recounting Red-tailed Hawks in the evening, though we believe this explanation to be less likely. By integrating GPS transmitter data into an otherwise field-related question, we were able to assess the conspicuousness of Red-tailed Hawks based on time of day in a less biased manner. Overall, these findings lead us to suggest surveys conducted in the morning and afternoon can be compared, while evening surveys may demonstrate higher than average Red-tailed Hawk sightings, possibly due to an increase in activity and subsequent visibility.

Quantifying Eagle Vehicle Strike Risk to Inform Conservation Practices

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Roads are ubiquitous throughout the range of the Bald Eagle (*Haliaeetus leucocephalus*) and Golden Eagle (*Aquila chrysaetos*) in the U.S. Both eagles species are susceptible to vehicle strikes when feeding on road kill, particularly during winter mos when live prey is less available, but the scope and dynamics of this issue are poorly understood. We report on the first two yrs of study investigating winter Eagle activity and mortality along roads in Oregon, Utah, and Wyoming. We performed repeated driving surveys to record available carcasses and sightings of live eagles, walking and dog surveys of right-of-ways (ROW) to detect additional carcasses, and placed camera traps on a subset of carcasses to quantify Eagle use patterns along approximately 3219 km of road. A minimum of 25 Eagle mortalities were found on or near roads, and Eagle density, carcass feeding, and Eagle mortality events were temporally and spatially correlated with road kill abundance. Walking surveys of ROWs along 70,000 Eagle-carcass use photos and 100s of unique Eagle-vehicle interactions. We present preliminary metrics from photographs

and sequences illustrating Eagle response to vehicles. Our goal is to identify activity patterns and flushing thresholds of Eagles in relation to distance to road, road characteristics, and vehicle type to guide road kill relocation plans that will minimize Eagle vehicle strikes. Additionally, our data will allow more realistic estimates of winter Eagle mortality associated with specific roadways. These products will facilitate the quantification of Eagle conservation achievable under various roadway management scenarios.

Climatic Niche of the Saker Falcon: Predicted New Areas of Climatic Suitability to Direct Population Surveys

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Accurate species distribution data across remote and extensive geographic areas are difficult to obtain. Here, we use climate envelope models to determine climatic constraints on the distribution of the migratory Saker Falcon (*Falco cherrug*) to locate unknown populations in data-deficient regions. Sakers live at low densities, across large ranges in remote regions, making distribution status difficult to assess. We show the utility of Species Distribution Modeling to address distribution knowledge gaps, and target surveys for this endangered species. Using presence-background data and eight bioclimatic variables, we applied the MAXENT algorithm to construct bioclimatic envelope models for both breeding and wintering ranges. Occurrence data were spatially-filtered and climatic variables tested for multicollinearity, before selecting best fit models using Akaike Information Criteria (AIC) by tuning MAXENT parameters. Biogeographical interpretations were based on predicted climatic suitability, response curves and jack-knife tests of variable importance. Model predictive performance tested using Boyce Index was high for both breeding (BTEST = 0.956) and wintering models (BTEST = 0.909), with low omission rates and minimal overfitting. The Sakers Falcons' climatic niche was defined by precipitation in the warmest quarter in the breeding range model, and mean temperature wettest quarter in the wintering range model. Projecting models to remote regions with low survey coverage identified new areas to guide exploratory surveys in western China. The bioclimatic envelope models given here accurately predict areas of highest climate suitability and define the climatic constraints on a wide-ranging rare species, suggesting that climate is a key determinant of Saker Falcon distribution across macro-scales. We recommend targeted population surveys for the Saker Falcon based on model predictions to areas of highest climatic suitability in key range

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states with distribution knowledge gaps. Further applications of the models could identify protected areas and reintroduction sites, inform development conflicts, and assess climate change impacts.

Owls and Their Feet: Mow Morphology Relates to Diet

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Present day Owl species are the result of a long evolutionary history. Among adaptive pressures shaping species traits, food resources are thought to have played a key role through time. Indeed, several studies have shown the remarkable auditory and visual capabilities in Raptors and Owls. Morphologically, wing size and feathers in general have also received some scientific attention, but there is still a lot to be learned regarding foot morphology. Because feet and talons play a critical role in the food acquisition and ingestion in Raptors and Owls, we aimed to assess if foot morphology (corrected for body size) is associated with dietary habits (specialists vs generalists). We hypothesized that foot morphology (total foot pad size, digit length, talon/digit length ratio, talon curvature) would show a relatively higher intraspecific variability in generalist than specialist species. Moreover, we assessed if foot morphology in Owls correlates with the size and type (terrestrial, avian, or aquatic) of the main prey items for each Owl species. We photographed and measured feet in 400 live as well as 75 museum specimens from 16 Owl species ranging from small (e.g. *Otus*, *Aegolius*), medium (e.g. *Tyto* and *Asio*) and large (e.g. *Bubo* spp.) species. The results from this ongoing study will reinforce the tight evolutionary link between morphology and diet and might help decipher evolutionary trajectories in Owls.



Western Banded Snake Eagle | Photo by André Botha



African Harrier Hawk | Photo by André Botha

CODE OF CONDUCT

The Raptor Research Foundation's Code of Conduct is available at:

<http://www.raptorresearchfoundation.org/conferences/current-conference/code-conduct/>

The Raptor Research Foundation hosts an annual conference to exchange and disseminate scientific information on birds of prey including ecology, behavior, evolution and conservation. Because effective exchange of ideas is best accomplished in a friendly and open environment, it is fundamental to ensure that conference attendees treat each other with courtesy and respect in all interactions, including face-to-face, written, or electronic. For this reason, RRF places special care and emphasis on provisioning and ensuring a safe, hospitable, and productive environment for everyone attending its annual meeting, and any other RRF-sponsored event, regardless of ethnicity, nationality, religion, disability, physical appearance, gender, age, or sexual orientation. We take this aspect of our mission very seriously and expect all conference attendees to behave courteously, respectfully, and professionally to each other, to RRF employees and representatives, to conference volunteers, exhibitors and local meeting venue staff.

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Definitions

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Harassment—A course of conduct which threatens, intimidates, alarms, or puts a person in fear of their safety. Harassment is unwanted, unwelcomed and uninvited behavior that demeans, threatens or offends the victim and results in a hostile environment for the victim. Harassing behavior may include, but is not limited to, epithets, derogatory comments or slurs and lewd propositions, assault, impeding or blocking movement, offensive touching or any physical interference with normal work or movement, and visual insults, such as derogatory posters or cartoons (<https://definitions.uslegal.com/h/harassment/>).

Reporting an Incident

Any attendee who believes that he or she has been subjected to a violation of the Code of Conduct, notices that someone else is being subjected to a violation of the Code of Conduct, or has any other concerns about the appropriateness or professionalism of individual's behavior at any RRF-sponsored event should contact any member of the Code of Conduct Committee or RRF Board. He or she will be not required or expected to discuss the concern with the person thought to have potentially violated the Raptor Research Foundation Code of Conduct. All allegations will be treated seriously and investigated during the RRF-sponsored event itself to the extent practical, or will be investigated as efficiently as possible thereafter. Confidentiality will be honored to the extent permitted as long as the rights of others are not compromised.

Disciplinary Action

Individuals engaging in behavior prohibited by the RRF Code of Conduct will be subject to disciplinary action. RRF leadership may take any action they deem appropriate, ranging from a verbal warning to ejection from the meeting or activity in question without refund of registration fees, to expulsion from the Foundation in case of membership. Repeat offenders may be subject to further disciplinary action, such as being banned from participating in future meetings. Note that RRF has the authority in its Bylaws to terminate the membership of any member after fair and reasonable consideration all of the relevant facts and circumstances. Disciplinary action will apply to all offenders participating in the conference, from non-RRF members to Board Directors.

CODE OF CONDUCT

Retaliation Is Prohibited

RRF will not tolerate any form of retaliation or attempt at dissuasion against individuals who file a complaint or assist in the investigation, either by the original offender, or by any individual on his/her behalf, or by the Board member who receives the initial complaint. Retaliation is a serious violation of this policy and, like harassment or discrimination itself, will be subject to disciplinary action.

Questions & Appeal

Any questions regarding this policy should be directed to the RRF Code of Conduct Committee Chair, RRF Board, or the local conference committee, which will re-direct it to the Board of Directors. In the event that an individual involved in any reported incident is dissatisfied with the disciplinary action, he or she may appeal to the RRF Board, which will privately discuss the issue and vote for a decision.

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Thank you for helping us ensure a safe and inclusive conference for all participants and speakers!

SPEAKER INDEX

- Ali, Eissa (98)
Amar, Arjun (78)
Artens, Francis (74)
Askelson, Kenneth (79)
Barry, Jacqueline (98)
Batchelor, Garth (71)
Bednarz, James (83)
Beutel, Andreas (27)
Bickford, Nate (98, 99)
Bishop, Christine (61)
Bishop, Savannah (111)
Bolopo, Diana (71)
Bracebridge, Claire (36)
Brink, Christiaan (76)
Brown, Jessi L. (111)
Buechley, Evan (36, 99)
Buij, Ralph (37)
Byholm, Patrick (111)
Calvin, Michael (56)
Camina, Alvaro (77, 112)
Chetty, Kishaylin (27)
Chosh, Yael (37)
Clark, William (79)
Cococetta, Ciro (61, 100)
Coverdale, Brent (37, 41)
Davies, John (80)
Deacon, Neil (56)
Deak, Gabor (61)
Dell'omo, Giacomo (69)
Dickson, Ariana (88)
Diez, Maialen Azpillaga (88)
Duriez, Olivier (38, 56, 100)
Dwyer, James (27, 28, 31, 33)
Dykstra, Cheryl (45)
Efrat, Ron (100)
Elliott, John (45, 62)
Etterson, Matthew (101)
Feas, Fernando (57)
Forsman, Johan (62)
Gahbauer, Marcel (112)
Gallego, Diego (89)
Garbett, Rebecca (62, 112)
Garcia-Heras, Marie-Sophie (83)
Garcia, Maria Eugenia Cabrera (92)
Gibbons, Andrea (113)
Goodwin, Warren (101)
Gore, Meredith (49)
Gosford, Robert (70)
Gross, Darren (73)
Gura, Katherine (101)
Hadjikyriakou, Thomas (84, 85)
Halmos, Gergo (29)
Harness, Richard (27, 28, 31, 33)
Harrell, Reginal (49, 51)
Hart, Lorinda (70)
Hatfield, Richard (77)
Heck, Nikki (28)
Hoogstad, Constant (29)
Horvath, Marton (29, 113)
Howes, Caroline (84)
Huysman, Allison (81)
Hyde, Noel (57)
Johnson, Jeff (79)
Jordan, Lara (38, 92, 95)
Kaltenecker, Gregory (39)
Kanaujia, Amita (39)
Katzner, Todd (85)
Kemper, Cindy (30)
Kennedy, Patricia (82)
Kenward, Robert (57)
Kibuule, Michael (102)
Koronkiewicz, Thomas (72)
Krone, Oliver (63)
Kruger, Rudi (30)
Kumar, Adesh (93)
Lamont, Myles (102)
Lanzone, Michael (70)
Leepile, Leungo B.L. (93)
Leeuwner, Lourens (30)
Losee, Michele (81)
Lowney, Anthony (89)
Macias-Duarte, Alberto (86)
Manchi, Shirish (81)
Mannan, Bill (47)
Manqele, Nomthandazo (50)
Maphalala, Machawe I. (93)
Martin, Audrey (94)
McClure, Christopher (74)
McGough, Lauren (57)
McGowan, Brian (31)
McGrady, Michael (115)
McLaren, Bruce (27)
McPherson, Shane (58)
Mendez, Diego (94, 115)
Menq, Willian (116)
Meyburg, Bernd (86, 103)
Millar, Jody Gustitus (103)
Miller, Tricia (84)
Mishra, Shivangi (103)
Mojica, Elizabeth (32)
Mooney, Nick (32, 67)
Munoz-Garcia, Violeta (116)
Murgatroyd, Megan (67)
Murn, Campbell (39, 40, 104, 105)
Morrow, Jennifer (49)
Natsukawa, Haruki (117)
Nebel, Carina (90)
Nkmono, Merlyn Nomusa (116)
Obermayer, Brennan (117)
Ogada, Darcy (40, 42, 95)
Oleyar, Dave (67)
Orozco-Valor, Paula M. (104, 114, 118)
Ottinger, Mary Ann (50)
Owolabi, Bibitayo Ayobami (75)
Panuccio, Michele (87)
Paprocki, Neil (82)
Parry-Jones, Jemima (40)
Perez-Garcia, Juan Manuel (32, 115, 118)
Pfeiffer, Morgan (41)
Potier, Simon (58, 105)
Prommer, Matyas (59, 118)
Ralston-Paton, Samantha (68)
Razakartrimo, Stephanie (72)
Rene de Roland, Lily-Arison (75)
Reson, Eric (51)
Ruddock, Marc (75, 119)
Ruffo, Alazar Daka (51)
Sanchez-Virosta, Pablo (64)
Santander, Francisco (68)
Santangeli, Andrea (52)
Sarasola, Jose Hernan (120)
Schlater, Shannon (82, 120)
Scott, Teague (42)
Shaffer, L. Jen (52)
Sharma, Daya Shanker (45)
Shema, Sidney (105)
Sielicki, Janusz (33, 59)
Simmons, Robert (69)
Sinha, Ankit (105)
Slabe, Vincent (64)
Slater, Steve (95, 121)
Smit-Robinson, Hanneline (53)
Smith, Jeff (69)
Solheim, Roar (96, 106)
St. George, Dane (77)
Starikov, Ivan J. (106)
Steiner, Ryan (90)
Sumasgutner, Petra (46, 107)
Sutton, Luke J. (121)
Tate, Gareth (73)
Tavares, Jose Pedro (42, 87)
Therrien, JF (122)
Thompson, Lindy (43)
Thompson, Robert L. (114)
Vali, Ulo (108)
Van Den Heever, Linda (53)
Van Zyl, Anthony (76)
Vennum, Christopher (80)
Venu, Prabha (96)
Wachira, Washington (108)
Whitecross, Melissa (71)
Wommack, Elizabeth (78)
Wrona, Anna (109)
Yadav, Ruby (109)



Brown Snake Eagle and Fork-tailed Drongo
photo by André Botha