Raptor Research Foundation

50th Anniversary

2016 ANNUAL CONFERENCE

OCT 16-20 | CAPE MAY, NJ

NEW JERSEY AUDUBON
www.njaudubon.org

Cape May Bird Observatory
New Jersey Audubon
www.birdcapemay.org

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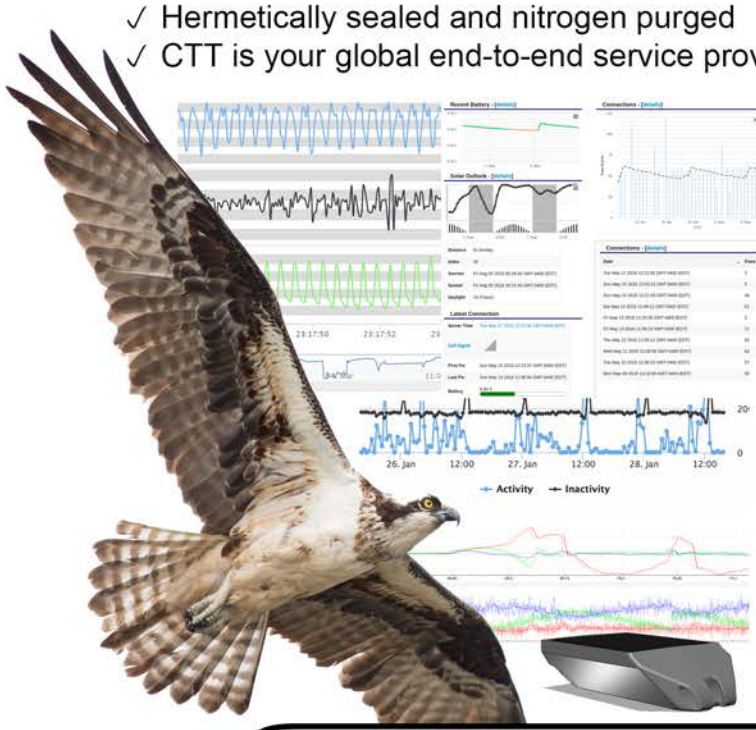

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Conference Quick Schedule

Sunday, October 16

8 AM - 5 PM	Avian Power Line Interaction Committee Workshop (APLIC)	see page 18 for details
8:30 AM - 5 PM	Analysis: A Professional Development Course in Telemetry	see page 18 for details
8 AM - 12 PM	ECRR Workshop - Raptor Trapping at Cape May	see page 18 for details
10 AM - 12 PM	ECRR Workshop - Raptor Trapping and Handling Techniques	see page 18 for details
8 AM - 12 PM, 1-5 PM	ECRR Workshop - Harnessing Raptors with Transmitters	see page 18 for details
8:30 AM - 12 PM, 1-4:30 PM	ECRR Workshop - Techniques for Handling, Auxiliary, Measuring, and Blood Sampling Raptors	see page 18 for details
8 AM - 12 PM	ECRR Workshop - Raptor Necropsy	see page 18 for details
8 AM - 4 PM	ECRR Workshop - Raptor Field and In-hand ID, Ageing and Sexing, Recent Taxonomic Changes in Raptors, and Molt and Its Use in Ageing	see page 18 for details
6-8 PM	Ice Breaker/Welcome Reception (sponsored by ECRR) wth lite fare and cash bar	5th Floor Penthouse Ballrooom

Monday, October 17

8-9 AM	Announcements and Plenary Speaker by Dr. Ian Newton	5th Floor Penthouse Ballrooom
9-9:40 AM	Understanding, Appreciation, and Conservation of Birds of Prey for Over 50 Years	5th Floor Penthouse Ballrooom
10-11:40 AM	Population Monitoring	1st Floor Ballroom A
10 AM - 4:40 PM	Urban Raptors Symposium	1st Floor Ballroom B
10 AM - 4:40 PM	50 Year Anniversary Symposium	1st Floor Ballroom C
12:15-1 PM	Scientists and Public Policy: Yes, You Can! Yes, You Should! (by Ellen Paul)	Crystal Room on Ground Floor
1:20-4:40 PM	Migration and Movement	1st Floor Ballroom A
5-6 PM	Poster Session	5th Floor Penthouse Ballrooom
6-8 PM	Poster Reception with lite fare and cash bar	5th Floor Penthouse Ballrooom

Tuesday, October 18

8-9 AM	Announcements and Plenary Talk by Dr. Carol McIntyre	5th Floor Penthouse Ballrooom
9-9:40 AM	Second Plenary Panel: Women in Raptor Research	5th Floor Penthouse Ballrooom
10-11:40 AM	Conservation	1st Floor Ballroom A
10 AM - 4:40 PM	Snowy Owl and Short-eared Owl Symposium	1st Floor Ballroom B
10-11:40 AM	Speed Talks	1st Floor Ballroom C
1:20-4:40 PM	Methods and Techniques	1st Floor Ballroom A
1:20-4:40 PM	Lead and Raptors Symposium	1st Floor Ballroom C
10 AM - 2 PM	Shuttles to Cape May Hawkwatch	front of Grand Hotel
5:30-7:30 PM	Dinner Cruise on Cape May	see page 16 for details

Wednesday, October 19

8-9 AM	Announcements and Plenary Talk by Dr. Yossi Lesham	5th Floor Penthouse Ballrooom
9:20-10:40 AM	Northern Saw-whet Owl Symposium	1st Floor Ballroom A
9:20-10:40 AM	Anderson Award	1st Floor Ballroom B
9:20-10:40 AM	Raptor Health	1st Floor Ballroom C
11:20 AM - 2:40 PM	Behavior	1st Floor Ballroom A
11:20-11:40 AM	Breeding and Behavior of Owls	1st Floor Ballroom B
11:20 AM - 2:40 PM	Habitat Use	1st Floor Ballroom C
1:20-3:40 PM	Energy Infrastructure	1st Floor Ballroom B
6-8:30 PM	50th Anniversary Banquet and Dance Party	5th Floor Penthouse Ballrooom

Thursday, October 20

8 AM - 2:30 PM	Cumberland County Hotspots field trip	see page 17 for details
8:30 AM - 4 PM	A Day of Hawkwatching with Frank Nicoletti field trip	see page 17 for details
7 AM - 2:30 PM	Cap May Migration Grand Slam with Tom Reed field trip	see page 17 for details
7-9 AM, 10 AM - 12 PM, 1-3 PM, 4-6	An Exclusive Cape May Raptor Banding Experience field trip	see page 17 for details

Table of Contents

Nick Bradsworth, Powerful Owl

Hosts

Raptor Research Foundation
www.raptorresearchfoundation.org

Founded in 1996 and celebrating 50 years in the field, 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 promote their conservation.

New Jersey Audubon
www.njaudubon.org

New Jersey Audubon fosters environmental awareness and a conservation ethic among New Jersey's citizens; protects New Jersey's birds, mammals, other animals, and plants, especially endangered and threatened species; and promotes preservation of New Jersey's valuable natural habitats.

Cape May Bird Observatory
www.birdcapemay.org

The Cape May Bird Observatory was founded by New Jersey Audubon in 1975 to keep a finger on the pulse of migration in one of the most important locations for migration in the world. This is accomplished through the Cape May Hawkwatch, Avalon Seawatch, Morning Flight, Songbird Counts, and Monarch Monitoring Project.

Cape May Raptor Banding Project
www.capemayraptors.org

Raptor banders have been operating at Cape May, New Jersey since 1967. The group became incorporated in 1999 as Cape May Raptor Banding Project, Inc. (CMRBP), a 501c(3) non-profit organization. As of 2015, CMRBP has captured and banded over 146,000 raptors of 16 different species during fall migration, making it the largest raptor banding project in North America and one of the largest projects in the world.

Welcome from RRF

On behalf of the Raptor Research Foundation, welcome to the 2016 RRF annual conference. This is a unique time in RRF history, as we gather in Cape May, New Jersey, one of the most beautiful and fascinating migration concentration points for birds (including raptors, of course), to learn about cutting edge raptor research and to celebrate the 50th anniversary of our organization. More than 200 delegates will attend the conference, not only from North America but from all around the world. They come to Cape May attracted by the location, the birds, and the knowledge they will obtain by attending the different sessions, symposiums and workshops. But I am sure that by the end of the conference all will leave Cape May with something else; the memories of celebrating 50 years of Raptor Research and Conservation, memories of comradery, friendship, pluralism and diversity. Last, but not least, you will take home the memories of the wonderful people from Cape May, New Jersey, that made this event unique.

This year we have an abundance of offerings, more than at any RRF conference. There is the amazing list of plenary speakers (Drs. Ian Newton, Carol McIntyre, and Yossi Leshem), the once in a lifetime plenary session on the role of Women in Raptor Research, several Symposia, including a special one about 50 years of Advancement in Raptor Science and Conservation. Hold on, we still have more: field trips, workshops (sponsored by the Early Career Raptor Research Committee), and a wide range of topics covered in oral and poster sessions presented by raptor researchers, many of whom are leaders in their fields. Not enough? Then let me mention an Evening Dinner Cruise on the waters of Cape May Harbor, a Banquet with Awards and a special Banquet presentation by one of our past Presidents, Dr. David Bird. For the grand finale, and to properly close a fantastic week, we will have an after Banquet party. No other conference gives you so much!

As for many other conferences, an unmeasurable number of hours of careful planning, email, skype and phone communication, hard work and sleep deprivation, together with commitment, passion and a lot of humor were necessary to move this event from a dream to reality. The local committee, led by Co-Chairs Lillian Armstrong and David La Puma, and all the local committee members and volunteers, together with the New Jersey Audubon Society's Cape May Bird Observatory and the Cape May Raptor Banding Project, our conference hosts, deserve our most sincere appreciation for organizing this year's conference. Please, take a few minutes during the next days to thank them for their hard work. They really went the extra mile not only to have a great conference but also to accommodate the celebration of our 50th anniversary. On behalf of RRF, thank you very much to all you.

I am proud of being involved in this organization. Raptor Research Foundation has been a very important part of my life for many years now, and if you ask why I can easily tell you the most important reason; the people. From Officers to Directors, from Committee Chairs to Committee members, from the Editor of the Journal of Raptor Research to the Associate Editors, translators, and reviewers, and of course, our members, they all make this organization something unique in the world. We are a great, diverse, multicultural, respectful, welcoming and friendly family. Leaving your town or city home to attend a RRF meeting is very easy, because every year you see faces that make you feel as if you never really left home at all. Thanks to all of you for making Raptor Research Foundation more than a scientific ornithological society.

I promised to be short and concise, but I cannot prevent myself from adding a few more lines to recognize those that worked very hard, together with the local committee, to make this year's conference a great success. Please join me in saying thanks to all RRF Officers, Directors, JRR Editor, Associate Editors, staff and reviewers, Committee Chairs and Committee members. A very special thanks goes to the RRF Conference Committee (Chair Jerry Niemi, Dan Varland, Kate Davis), the Scientific program Committee (Chair Elizabeth Wommack, James Dwyer, Evan Buechley, and Dylan Steffen), the Early Career Raptor Researcher Committee (Chair Joseph Eisaguirre, Bryce Robinson, Teresa Ely, Neil Paprocki, Megan Judkins, Matt Stuber, and Travis Boom), the Awards Committee (Gary Santolo, Jennifer Coulson, Jemima Parry Jones), and our Web Manager and Vice President Libby Mojica. Finally, I want to thank my fellow 50th Anniversary Committee members Jim Bednarz and Lloyd Kiff for their hard work in organizing the long list of activities aimed to celebrate this special anniversary of our foundation. Special thanks to all our vendors and sponsors for accompanying us one more time; some have been with us for many years, and we certainly want to acknowledge your help and generosity. And to all those that I involuntarily omitted here, thank you very much.

Enjoy the conference and the hospitality of the local committee and all the people of Cape May, New Jersey. You will never forget this conference. Go and live it fully! Otherwise, you may need to wait another fifty years to have and enjoy another event like this one!

Sincerely yours,
Miguel D. Saggese
President
Raptor Research Foundation

Welcome from the Mayor

Welcome to the City of Cape May, "The Nation's Oldest Seashore Resort"!

On behalf of our residents and businesses it is my honor and pleasure as Mayor to welcome all of you to the Raptor Research Foundation Conference hosted by the New Jersey Audubon from October 16 through October 20, 2016.

Based upon our City's long term partnership with New Jersey Audubon, it is our distinct honor to host this conference on it's 50th Anniversary. It is especially impressive that the Raptor Research Foundation Annual Conference is attracting an international group of scientists, ornithologists, biologists and academic researchers from over a dozen foreign countries, as well as the United States.

Because of Cape May's importance as a migratory pathway for birds of prey each fall, the City of Cape May is thrilled to collaborate with New Jersey Audubon and the Cape May Bird Observatory as we showcase the Cape May Peninsula as the destination which has been able to promote itself not only as a vacation destination, but has been touted as "Raptor Capital of North America."

As you enjoy the conference and the bird watching activities, please remember that some of the best hawk-watching on the east coast is located at the Cape May Point State Park. I encourage you to take advantage of all that the City of Cape May and our regional peninsula have to offer and enjoy your time in our "Historic Landmark City." I wish you great experiences during the conference and your birding activities.

Sincerely,

Dr. Edward J. Mahaney, Jr.

Dr. Edward J. Mahaney, Jr.
Mayor

Welcome from the Hosts

As the director of New Jersey Audubon's Cape May Bird Observatory, please let me welcome you to Cape May, better known as the migration mainline. Whether this is your first time, or your hundredth, Cape May always has something for you, and if raptors are your thing, you've come to the right place at the right time! Cape May boasts some spectacular raptor migration and our 40 years of data collection have documented many important trends, such as the rebound of Bald Eagles and Osprey following the ban on DDT, as well as the resurrection of the Peregrine Falcon through a successful and groundbreaking reintroduction program. Our data also show declines in American Kestrel, something that is corroborated by our fellow hawkwatch sites north and west of us. We also see both declines in Sharp-shinned Hawks and increases in Cooper's Hawk, two trends that underscore the need for further research into the causes of these apparent population changes.

The point is, the work you are doing to understand raptor populations is critical to our conservation of these species for future generations, and I speak for our entire organization when I say we welcome you to work with us to help answer the pressing questions of today and tomorrow. Our various committees have worked hard to ensure you have a diverse array of experiences at your fingertips while you are here, from globally important plenary speakers, to a diverse array of presentations on many topics, to some exceptional excursions so you can witness firsthand the spectacle of migration here in the Cape May region. Here's to a wonderful week of raptors in Cape May!

David A. La Puma, PhD
Director, Cape May Bird Observatory
New Jersey Audubon

Welcome to the Annual RRF Meeting in Cape May and the 50th Anniversary of RRF!

Cape May – what a great place to have the annual meeting! Cape May is a historic town (named in 1620) and the oldest seaside resort community in the US. I want to personally welcome you to the meeting and all of the exciting activities, field trips and scientific talks, including a review of RRF over the past 50 years, and culminating in the 50th Anniversary Party after the banquet on Wednesday night. I trust you will also have an enjoyable meeting as you gather and share ideas with new and old friends. Thanks for coming and I look forward to meeting all of you again or for the first time. Enjoy the meeting, the town, and Cape May Bird Observatory.

Gerald 'Jerry' Niemi
RRF Conference Committee Chair
RRF Board of Directors

Raptor Research Foundation

50 YEARS 1966-2016
50 years
106 board members
countless volunteer hours
THANK YOU! (see pages 85-86)

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Scientific Program

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Kate Davis

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Gary Santolo
Jennifer Coulson
Jemima Parry Jones

50th ANNIVERSARY COM.

Miguel D. Saggese, Chair
Jim Bednarz
Lloyd Kiff

Acknowledgments

The RRF conference takes a small army to organize each year. In addition to our hosts, there are many people we want to thank for their time and talents in organizing all aspects of the conference, workshops and field trips. The program booklet was a collabration between designer Joseph Dane and editors Lillian Armstrong and Rene Buccinna, with editing and proof reading help from Dan Varland, Jerry Niemi, and David La Puma.

Volunteers

A big thanks to the many volunteers who donated their time to make sure the conference ran smoothly.

Moderators

Thanks to the following conference moderators: Benjamin Skipper, Rob Bierregaard, Dave Oleyar, Jesse Watson, Jemima Parry-Jones, Libby Mojica, Joan Morrison, Adam Duerr, Jim Bednarz, Lloyd Kiff, Miguel Saggese, Clint Boal, Cheryle Dysktra, Marcel Gahbauer, Dave Brinker, Todd Katzner, Oliver Krone, and Katy Duffy.

Contributing Artists

Only raptor photos here; we'll leave those cat photos for Facebook. We want to thank the following photographers for generously donating their photographs for the program book.

Front cover:
Ray MacDonald Photography
www.ray-macdonald.com

Back cover:
1. Marcel Gahbauer, Short-eared Owl
2. Kym Bradley, White-tailed Eagle
3. Kate Davis, Osprey
4. Nick Bradsworth, Powerful Owl

General Session Abstracts
1. Trost Jolsen, Wedged-tailed Eagle
2. Marcel Gahbauer, Great Grey Owl
3. Al Hinde, Ferruginous Hawk

Speed Talks
1. Jerry Liguori, Peregrine Falcon
2. Jeff Zirpoli, Burrowing Owl
3. Aaron Winters, Snowy Owl

Poster Abstracts
1. A. Beardsell, Snowy Owls
2. Styhl Tyrell, Osprey
3. Marg. DiBenedetto, Golden Eagle

David Kiehm, Dead Drift Studio

Featured artist, www.deaddriftstudio.com

Raptors are one of David's foravore subjects. Preview some of his work in the Wicker Room during hte conference. Then meet artist and take home a favorite piece with you on Wednesday evening.

Sponsors

The Raptor Research Foundation Conference organizers and participating organizations are extremely grateful to our sponsors. We thank you for your support!

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Vendors

Be sure to stop in the Atrium on your way to the paper sessions or coffee breaks to visit with our conference vendors. They will set up on Sunday, and be available thru 3pm on Wednesday.

Cellular Tracking Technologies, Inc:
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.

Pepco Holdings,
www.pepcoholdings.com

An Exelon company, Pepco Holdings consists of three regulated electric utilities, Atlantic City Electric, Delmarva Power and Pepco, delivering electricity and gas to over 1.8 million customers in Delaware, the District of Columbia, Maryland, Virginia and New Jersey. PHI maintains a strong commitment to enhancing the communities that they serve. Environmental stewardship is one of PHI's central values, guiding business operations, regulatory compliance and resource conservation efforts. This includes implementation of a comprehensive avian protection program designed to minimize the potential for bird electrocution or collision with overhead towers, poles and wires infrastructure.

Lotek, Biotrack, and Sirtrack
www.lotek.com

Lotek and partner companies specialize in the design and manufacture of wildlife tracking systems. Our products allow researchers to track animals, birds, and fish of almost any size, in almost any environment. We are proud to be partners in wildlife research being conducted in more than 100 countries. Our craft is biotelemetry technology; our passion is the environment.

Buteo Books
www.buteobooks.com

Buteo Books is an independent family-owned bookstore carrying one of the largest selections of birding books in the world.

Conserve Wildlife Foundation of New Jersey (CWF)
www.conservewildlifenj.org

CWF has worked to protect rare wildlife in New Jersey and beyond for over two decades. CWF biologists and educators utilize field science, habitat restoration, environmental education, public engagement, and volunteer stewardship to ensure our most vulnerable wildlife species can continue to call New Jersey home.

Hawk Migration Association of North America
www.hmana.org

Hawk Migration Association of North America (HMANA) works to advance the scientific knowledge and promote conservation of raptor populations through study, enjoyment, and appreciation of raptor migration." HMAMA collects hawk count data from almost two hundred affiliated raptor monitoring sites throughout the United States, Canada, and Mexico, publishes the semi-annual journal Hawk Migration Studies, provides HawkCount, a near-real-time international database of hawk counts across the continent, and is a driving force behind the Raptor Population Index (RPI), to promote scientific analysis of hawk count data.

General Information

Welcome to Cape May! Following are some important items to help you get your bearings and answer some of your questions. Please refer to the hotel floor plan in this booklet for room locations.

Registration for the 50th Annual Meeting of the Raptor Research Foundation includes your welcome packet, conference program, and admission to all Symposia, Plenaries and General Sessions. It also covers the following:

- Coffee/snack breaks (see next page for times and locations)
- Welcome/Icebreaker Reception sponsored by Early Career Raptor Researcher on Sunday evening
- Poster Session and Social on Monday evening
- 50th Anniversary Celebration on Wednesday night (immediately follows banquet)
- Trolley Shuttles to the Cape May Hawkwatch (Tuesday and Wednesday)
- Commemorative "goodies" and your welcome bag
- Conference related hotel charges (meeting rooms, a/v equipment, sound, etc.)

In addition, please note that the cost of your registration helps to subsidize lodging and travel expenses for Plenary Speakers, and also facilitates the lower cost of student registration.

Registration/Information Desk

A registration/information desk is set up in the 1st Floor Wicker Room of the Grand Hotel of Cape May for the duration of the conference.

On-site registration for new registrants, as well as check-in for those who have pre-registered, will be available at the following times:

- Saturday, October 15: 2 - 5 PM
- Sunday, October 16: 12 - 7 PM
- Monday, October 17: 7 AM - 6 PM
- Tuesday, October 18: 7 AM - 6 PM
- Wednesday, October 19: 7 AM - 1 PM
- Thursday, October 20: 7 - 10 AM

Note: Please wear your name tag at all times, as it serves as your admission ticket to all events covered by your registration fee.

Message Board

A message board will be maintained next to the Registration/Information desk throughout the meeting. Please check it often, as it will be used for important updates, requests for rides, etc.

Internet Access

Wireless internet access is available throughout The Grand Hotel. The password is provided to you when you check into your room. Otherwise, ask at the front desk, or our registration desk.

Fax and Copying

For fax and copy service, go the hotel front desk. Charges are $1 per page to send a fax, and $0.25 per page for copies. If having a fax sent to you at the hotel, please tell the sender to put attention your name on the cover sheet. Hotel fax number is 609-884-4344.

Automated Tellers
There is an ATM located in the main lobby of The Grand Hotel.

Parking
The hotel has free parking on site. You may also park on the street, but be aware that parking meters are active along Beach Avenue. There are no meters on the block behind the hotel. However please be courteous to residents and avoid blocking driveways, etc.

Special Needs
The Grand Hotel and all meeting rooms are handicapped accessible.

Conference T-Shirts
Special 50th Anniversary Conference T-shirts are available in the Wicker Room for $20 while supplies last; sizes S, M, L, XL, and XXL. Get yours before they're gone!

Raptor Research Foundation Membership
If you are not a member of the Raptor Research Foundation at the time of registration, please note that the increased price of non-member registration includes membership. This means that by registering as a non-member, you are automatically enrolled as a member effective January 1, 2017.

Coffee Breaks
We know how important coffee is. Here's where you can find it:
- Hotel Lobby: 7 - 9 AM daily
- 5th Floor Lounge: 7 - 9:30 AM Mon/Tues/Wed
- Twitty's Porch: 9:30 - 11:30 AM and 2 - 3:30 PM Mon/Tues/Wed

At other times, please patronize Hemmingway's Restaurant, located on the first floor off the lobby. There is also a 24-hour Wawa convenience store about 1 mile away, on your way out of Cape May.


Kate Davis, Peregrine Falcon

Hemingway's Restaurant
Located on the 1st floor off the hotel lobby, Hemingway's is a full service restaurant.
Hours for the duration of the conference are:
- 7 - 11 AM breakfast
- 12 - 3 PM lunch
- 4 - 9 PM dinner

Restrooms
Restrooms are located on the 1st Floor, just outside the Atrium and Crystal Rooms. There are also restrooms on the 5th Floor lounge, as well as on the 1st floor at the end of Twitty's Porch. Restrooms on the first floor (to the left as you enter the lobby) have handicapped accessible stalls.

Scientific Program

All symposia and general paper sessions will be held in the 1st Floor, Grand Ballroom. From the lobby, go halfway down the hall and up the ramp. The ballroom is divided into 3 sections, Grand Ballroom A, B and C. Please check your schedule for the location of sessions you are planning to attend.

All plenary talks will be held in the 5th Floor Penthouse Ballroom.

Oral Presenters

Please take note of your presentation date and time. Please note that all presentations should be limited to 20 minutes total. This total includes 3-5 minutes for questions at the end of your presentation. It is extremely important that we maintain this schedule, so that attendees are able to move amongst the sessions and breaks as scheduled.

All oral presenters are asked to bring their power point presentations for loading onto the appropriate computer the day prior to your presentation if at all possible. Please make sure your power point file title uses the following format: "Day_Time__Location_LastName" (i.e. Mon-0910_GBA_Smith) Computers for uploading presentations are located in the 1st Floor Wicker Room. There will be someone available in the Wicker Room from 7 AM - 7 PM Sunday thru Tuesday to accept and load your presentation.

Posters

The poster session will be held on Monday, October 17 in the 5th floor Penthouse Ballroom from 6 - 8 PM. Poster display boards will be set up and available to presenters by noon on Monday. Volunteers from the local committee will be available from 12 - 3 PM to provide supplies and assist if needed.

The poster display boards are 4' X 8' foamcore pegboards on a wooden frame. There will be 2 posters per side, per board. Posters may be attached to the display boards with push pins, staples, tape, etc. Poster positions are on a first-come, first-served basis.

All authors should be at their posters and prepared to discuss their work from 6 - 8 PM on Monday evening. Posters may remain on display until Wednesday morning. All posters must be removed no later than noon on Wednesday.

Vendors

We have several vendors who will be present throughout the conference. All vendors will be located in the Atrium, at the top of the ramp by the Grand Ballroom entrances. Please stop by and visit!

Notice to all attendees: As a courtesy to all presenters, we request that all attendees turn off all cellular phones while attending the symposia, meetings, or general sessions.

Local Nature Centers and Birding Hotspots

Located at the southernmost tip of New Jersey, Cape Island is a man made island separated from the rest of the Cape May peninsula by the Cape May Canal, Cape Island Creek and Cape May Harbor. The area, only 8-square miles, is a well-recognized, critical stopover for major concentrations of fall migrants. Cape Island includes some of the world's most famous birding locations: The Nature Conservancy's Cape May Migratory Bird Refuge "the Meadows", Higbee Beach Wildlife Management Area, Cape May Point State Park, and more. The island consists of a wide variety of habitats from beach, dune, and tidal salt marsh to small woodlots and fallow fields of Lower Township and West Cape May, to lawns and gardens of Cape May and Cape May Point. The island also continues to host the nation's oldest beach resort community.

Following are site descriptions for some of Cape Island's fall birding hotspots and nature centers. Each site description includes general information about the site and birds you would expect to find, GPS location, and driving directions. Refer to the RRF Cape Island birding map for orientation.

Cape May Bird Observatory | Northwood Center

701 E. Lake Drive, Cape May Point, NJ

Driving Directions: Garden State Pkwy to the end; proceed through traffic light over large canal bridge into Cape May on Lafayette Street. At the end of Lafayette, bear right at "T" then bear slightly left past Swain's Hardware store, passing 2 traffic lights. This becomes Sunset Blvd. Go straight to Lighthouse Avenue; left on Lighthouse; 2nd right onto East Lake Drive.

New Jersey Audubon's southernmost center was founded in 1975. This 2-acre preserve over looks Lake Lily in Cape May Point. The Northwood Center is the perfect one-stop shop for the nature lover in everyone focusing on natural history information, finest selection of binoculars and spotting scopes (selected by optics expert, Pete Dunne), field guides, and a variety of books, clothing, jewelry, games and more for adults and children. Relax on the garden benches and enjoy the birds and the view.

Cape May Hawkwatch | Cape May Point State Park

305 Lighthouse Avenue, Cape May Point, NJ
GPS: 38.932883,-74.957953

Driving Directions: Follow directions above to Cape May Bird Observatory's Northwood Center. Stay on Lighthouse Avenue to its end. Park entrance on your left. Hawkwatch platform is at the far end of the parking lot.

Since 1976, CMBO has conducted a full-time hawk watch in the fall. The Hawkwatch is located in Cape May Point State Park at the Hawkwatch Platform (Wildlife Viewing Platform). A visit to the world-renowned Cape May Hawkwatch is a must! Stop by anytime dawn to dusk. You will find a crew of Associate Naturalists and the "official" hawk counter. Let the naturalists and volunteers help you identify any of the 19 species of raptor that might soar by heading south for the winter. The count is being sponsored this year by Swarovski Optik (www.swarovskioptik.us). Handicap accessible. No walking. Have a seat, raise your bins and look to the skies.

Cape May Point State Park

215 Lighthouse Ave., Cape May Point, NJ
GPS: 38.932658,-74.958749

Driving Directions: Follow directions above to Cape May Bird Observatory's Northwood Center. Stay on Lighthouse Avenue to its end. Park entrance on your left.

A vantage point for witnessing the spectacle of migrating hawks, eagles, and falcons, the Cape May Point State Park is without parallel in North America. More Peregrine Falcon and Osprey are tallied in each fall season than many birders will see in a lifetime. With a picturesque lighthouse, a network of clearly marked trails and boardwalks, beach, viewing platforms, covered picnic areas, and toilet facilities, it is the perfect spot to spend a day. Walking is on trails, boardwalk, and beach. The Red Trail is a ½-mile wheel-chair accessible boardwalk trail. The Yellow Trail is 1½ miles and covers different habitats including wetland marsh, coastal dune, and the beach. The Blue Trail is 2 miles and continues off the Yellow Trail with a longer hike along the beach and coastal dune.

Cox Hall Creek Wildlife Management Area

7 Shawmount Ave, Villas, NJ 08251
GPS: 39.006090,-74.941296

Driving Directions: From Cape May take Seashore Rd (Rt 626) north to Academy Rd (Rt 639). Turn left on Academy Rd, follow Fishing Creek Rd at Y intersection, staying on Rt 639. Continue to Bayshore Road (Rt 603) and right onto it. After 1/3 mile turn left onto Shawmount Ave. From north, take Rt 47 south to Bayshore Rd (Rt 603) at Green Creek. Turn right onto Bayshore Rd, drive about 2.5 miles to Shawmount Ave on right. Turn on Shawmount Ave and continue through gates to parking area. (Allow 25 minutes

from Cape May).

A preserved 253-acre former golf course with paved paths winding through former fairways, is now maintained as grasslands and savannahs, wooded copses, and a beautiful swamp forest along Cox Hall Creek. Great habitat for Barred and Great Horned Owls, Red-shouldered Hawks, Bald Eagles, woodpeckers, and numerous waterfowl. Considerable songbird fallouts have been seen in this area over the years. Walking is on paved and woodland paths. Residential area; please be considerate and park only in designated areas.

The Grand Hotel

1045 Beach Avenue, Cape May, NJ
GPS: 38.933049,-74.908239

Driving Directions: Take Garden State Parkway to the end and continue over the Cape May Canal Bridge into Cape May. Continue straight on Lafayette Street, pass over a small bridge and then make the first available left turn onto Sydney Avenue. Go one block and turn left on Washington St. Bear to your right and then turn right on Texas Avenue. The road becomes Pittsburgh Avenue. Continue to the "T" at Beach Ave. Turn right onto Beach Ave. Hotel will be about ¼ mile on your right.

Higbee Beach Wildlife Management Area

West End of New England Road (past 520 New England Road), Lower Township/Cape May
GPS: 38.961465,-74.960630

Driving Directions: From the Grand Hotel, head SW on Beach Ave. 1.2 mi to Broadway. Turn rt onto S. Broadway for approx. 0.3 mi to Sunset Blvd. Left onto Sunset Blvd (towards Cape May Point) for approx.. 0.7 mi, to S. Bayshore Dr (Rte 607). Rt onto Bayshore Dr; slight rt onto Bayshore Rd. Continue 1.4 mi to New England Rd. Left onto New England Rd for 1 mile, to Higbees Beach Rd. (Allow about 15 minutes from Cape May).

This property is owned and managed by the NJ Division of Fish, Game, and Wildlife. It is home to the largest stand of old growth forest south of the Cape May canal and famous for its dune forest, the last natural dune forest along the Delaware Bayshore. Birds on their southward migration are funneled down the Cape May peninsula, directly into Higbee Beach WMA. Comprised of fields, mature swamp forest, freshwater ponds and marsh and horse pastures, songbirds are often abundant here during spring and fall migration. Walking is on open field trails and forest edges.

Morning Flight | Observation Tower

South of Jetty Parking Lot, Higbee Beach

Morning Flight is the directed and often visible movement of migrant songbirds in the first few hours after sunrise. Most often, this movement occurs during southbound passage and involves species that typically migrate at night (e.g., warblers, sparrows, although some diurnal migrants (e.g., Eastern Kingbird, Northern Flicker) also engage in "morning flight." During these events, birds generally move in directions opposite their intended goal (e.g., north in fall). The flight can end abruptly two hours after sunrise or continue into the afternoon. CMBO researchers document this flight. Peak days tally tens of thousands of birds. To reach the tower, turn right onto the unpaved road at the west end of New England Road and park well in from the roadway.

Nature Center of Cape May

1600 Delaware Ave, Cape May, NJ
GPS: 38.945074,-74.899383

Driving Directions: Take Garden State Parkway to the end and continue over the Cape May Canal Bridge into Cape May. Continue straight on Lafayette Street, pass over a small bridge and then make the first available left turn onto Sydney Avenue. Go one block and turn left on Washington Avenue. Bear to your right and then turn right on Texas Avenue. The road becomes Pittsburgh Avenue. Go to Delaware Avenue and turn left. The Nature Center is two blocks down at the corner of Brooklyn and Delaware, on the right.

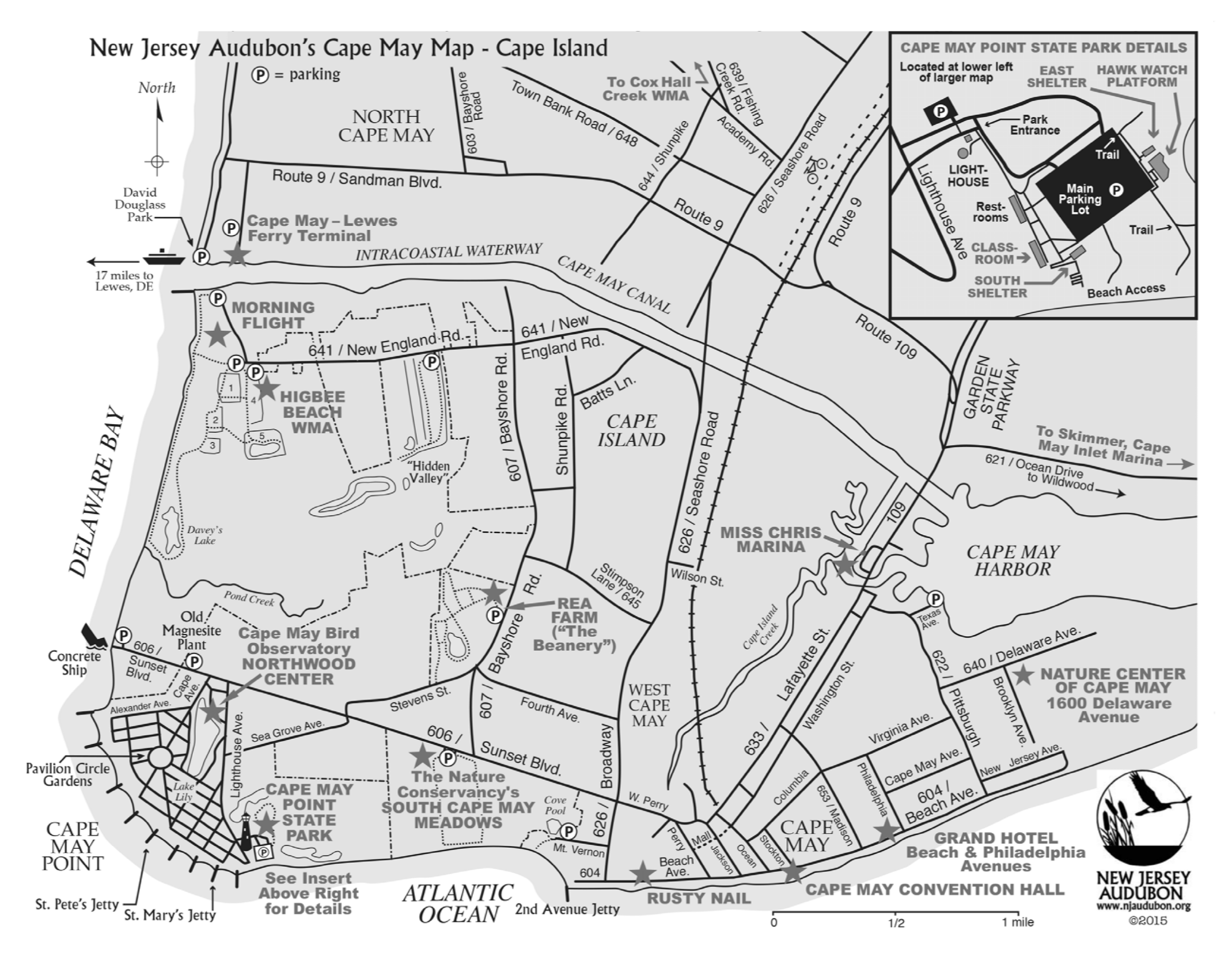
The Nature Center of Cape May is one of three NJ Audubon centers in Cape May County and specializes in children and family programs. There is a small gift shop with items for children and themed display gardens on the grounds. The tower overlooks Cape May Harbor.

The Nature Conservancy | South Cape May Meadows

Located across from 617 Sunset Blvd. (near intersection of Routes 606 & 607), Cape May
GPS: 38.937934,-74.944661

Driving Directions: From Grand Hotel, follow directions for Higbees Beach. The meadows are on Sunset Blvd., on your left just past Bayshore Dr.

Owned and managed by The Nature Conservancy (TNC), this 200 acre refuge includes critical foraging and resting habitat for birds and wildlife. The preserve's loop trail is replete with dunes, freshwater wetlands, meadows, ponds, and a full mile of protected beach. An excellent place to view gulls, terns, herons, egrets, shorebirds, bitterns, rails, and ducks. Walking follows a 1-mile loop trail over a combination of hard dirt paths and sand.


New Jersey Audubon's Cape May Map - Cape Island
P = parking
North
David Douglass Park
17 miles to Lewes, DE
Cape May – Lewes Ferry Terminal
INTRACOASTAL WATERWAY
CAPE MAY CANAL
NORTH CAPE MAY
603 / Bayshore Road
Town Bank Road / 648
To Cox Hall Creek WMA
639 / Fishing Creek Rd.
Academy Rd.
644 / Shunpike
Route 9 / Sandman Blvd.
Route 9
626 / Seashore Road
Route 109
GARDEN STATE PARKWAY
To Skimmer, Cape May Inlet Marina
621 / Ocean Drive to Wildwood
MORNING FLIGHT
641 / New England Rd.
HIGBEE BEACH WMA
"Hidden Valley"
Davey's Lake
DELAWARE BAY
607 / Baysshore Rd.
Shunpike Rd.
Batts Ln.
CAPE ISLAND
Stimpson Lane / 645
REA FARM ("The Beanery")
MISS CHRIS MARINA
CAPE MAY HARBOR
Wilson St.
Pond Creek
Old Magnesite Plant
Cape May Bird Observatory NORTHWOOD CENTER
Concrete Ship
606 / Sunset Blvd.
Cape Ave.
Alexander Ave.
Stevens St.
Fourth Ave.
WEST CAPE MAY
Cape Island Creek
Lafayette St.
Washington St.
Texas Ave.
622 / Pittsburgh
640 / Delaware Ave.
Brooklyn Ave.
NATURE CENTER OF CAPE MAY 1600 Delaware Avenue
Virginia Ave.
Cape May Ave.
New Jersey Ave.
Sea Grove Ave.
Lighthouse Ave.
606 / Sunset Blvd.
Broadway
633 / Madison
Columbia
Philadelphia
604 / Beach Ave.
Pavilion Circle Gardens
Lake Lily
CAPE MAY POINT STATE PARK
The Nature Conservancy's SOUTH CAPE MAY MEADOWS
Cove Pool
Mt. Vernon
626 / W. Perry
Perry
Mall
Jackson
Ocean
Stockton
CAPE MAY
GRAND HOTEL Beach & Philadelphia Avenues
CAPE MAY CONVENTION HALL
Beach Ave.
604
RUSTY NAIL
CAPE MAY POINT
See Insert Above Right for Details
St. Pete's Jetty
St. Mary's Jetty
ATLANTIC OCEAN
2nd Avenue Jetty
0
1/2
1 mile
CAPE MAY POINT STATE PARK DETAILS
Located at lower left of larger map
EAST SHELTER
HAWK WATCH PLATFORM
Park Entrance
Trail
LIGHT-HOUSE
Lighthouse Ave
Main Parking Lot
Rest-rooms
Trail
CLASS-ROOM
SOUTH SHELTER
Beach Access
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RRF Conference Socials

Conference attendees and their registered guests are invited to participate in a variety of social functions. Early Career Raptor Research (ECRR) and Poster receptions, as well as the 50th Anniversary celebration, are included in the cost of your registration. Please make sure to wear your name badge at all times, as it represents your admission to all included social events.

Sunday, October 16 | 6 - 8 PM

Icebreaker/Welcome Reception, sponsored by ECRR, with light noshes and cash bar available.

Monday, October 17 | 6 - 8 PM

Poster Session and social, with hors d'oeuvres and cash bar available. All authors should be present at their posters to discuss their work.

Tuesday, October 18 | 5:30 - 7:30 PM

Spirit of Cape May dinner cruise, with a beautiful night-time backdrop of Cape May Harbor. This 110 foot vessel is fully Coast Guard certified, with both indoor and outdoor seating. Dinner will be buffet style, with cash bar on board. Total cost for the cruise and dinner is $55 per person. If you have pre-registered, your ticket is included in your welcome packet. If you haven't pre-registered for the dinner cruise, tickets are available at the registration desk as long as space is available.

The "Spirit of Cape May" departs from the nearby Miss Chris Marina at 5:30 PM. Transportation is provided from the Grand Hotel of Cape May to the Miss Chris Marina in one of the Cape May Trolleys. The trolley will depart from in front of The Grand Hotel at 5 and 5:15 PM, and bring you back from your dinner cruise by about 8 PM.

Please note that the Spirit of Cape May is completely non-smoking, as required by law for all public places in the state.

Wednesday, October 19: | 6 - 8:30 PM

RRF 50th Anniversary annual banquet and awards ceremony, with special 50th Anniversary presentations will be accompanied by a delicious buffet-style dinner; a cash bar will be available. If you have pre-registered, your ticket is included in your welcome packet. If you haven't pre-registered, tickets are available at the registration desk as long as space is available. Cost is $65/person.

Immediately following the banquet will be our 50th Anniversary Dance Party at the same venue, so be sure not to miss this fun-filled evening! The celebration is open to all registrants, and is included in the cost of registration. DJ, cash bar and lite noshes will get the party going!

Tuesday and Wednesday, October 18 & 19 | Shuttles to the Cape May Hawkwatch

Cape May Shuttle–you just can't come to Cape May in the fall without a trip to the Cape May Hawkwatch! To be sure that everyone has an opportunity, we've arranged a trolley shuttle on Tuesday and Wednesday, October 18 and 19. Shuttle departs from the Grand Hotel and will run a continuous loop to the Cape May Point State Park from 10 AM - 2 PM each day. Shuttle cost is included in your registration. NO pre-registration needed; just wear your name badge. Travel time is approximately 10-12 minutes each way.

Field Trips

Cumberland County Hotspots

Thursday, October 20, 2016 | 8 AM- 2:30 PM
Trip leader: Pat and Clay Sutton
Cost: $75 includes lunch and transportation
Limited to 35

You can't mention raptors and Cape May without including Pat and Clay Sutton. An area native, Clay knows every inch of southern NJ. Join Pat and Clay on a trip through Cumberland County to their favorite haunts for fall migrants of every sort. Learn about the fact that some raptors arrive at Cape May Point, and rather than crossing the Delaware Bay there, they turn up the Bayshore instead. Includes lunch at the Oystercracker Café in Bivalve. Try their fried local oysters on a salad or a sandwich or a platter, homemade tuna salad, artisan grilled cheese or "Philly" style grilled portobello mushroom sandwich. Lunch also includes a cup of oyster chowder and a choice of homemade side dishes.

A day of hawkwatching

Thursday, October 20, 2016 | 8:30 AM- 4 PM
Trip leader: Frank Nicoletti
Cost: $50 includes lunch (not transportation)
Limited to 25

Spend some quality time hawkwatching with one of Cape May's most famous hawk counters, Frank Nicoletti. Learn his tips on putting a name to those specs in that patch of blue!

Cape May Migration "Grand Slam"

Thursday, October 20, 2016 | 7 AM- 2:30 PM
Trip leader: Tom Reed
Cost: $65 includes box lunch and transportation

Cape May is king for fall migration, and Tom Reed knows all of the migration count sites better than anyone! This field trip will visit each of the three fixed migration watch sites: the Morning Flight Songbird Count, Cape May Hawkwatch and Avalon Seawatch. As time permits and birds demand, we may visit a number of other hotspots based on the most recent reports of sightings.

An Exclusive Cape May Raptor Banding Experience

Thursday, October 20, 2016 | 7 - 9 AM, 10 AM-12 PM, 1-3 PM, 4-6 PM
Trip leader: Steve Felch, Ted Swem and Mike Harris
Cost: $25
Each Session limited to 6 individuals. Meeting point will be provided to registrants.

A truly unique experience in an active raptor banding station. You will experience the excitement of raptor banding, from watching the raptor approach, to trapping, banding and release. Note: we do not guarantee raptors. Some of Cape May's most experienced banders will be on hand to provide an inspiring and educational experience.

Other Conference Workshops

Scientists and Public Policy: Yes, You Can! Yes, You Should!

Monday, October 17, 2016 | 12:15 - 1:00 PM
Speaker: Ellen Paul, Executive Director of the Ornithological Council
Crystal Room on Ground Floor

Avian Power Line Interaction Committee Workshop (APLIC)

Sunday, October 16, 2016 | 8:00 AM - 5:00 PM
Grand Hotel 5th Floor Ballroom West
Class Size: 50 | Cost: Free

The purpose of this workshop is to provide training and informational resources to wildlife professionals that work on electric utility projects such as Avian Protection Plans or new transmission line construction projects. This course will provide a background on the types of avian issues relative to electric power lines (such as electrocutions, collisions, nests, and construction impacts), and will discuss various techniques to minimize avian impacts.

Analysis: A Professional Development Course in Telemetry

Part 1: Project Design & Trasmitter Attachment Methods
Sunday, October 16, 2016 | 8:30 - 10:00 AM

Part 2: Understanding Transmitters: Duty Cycles for Various Experimental Designs
Sunday, October 16, 2016 | 10:00 AM - 12:00 PM

Part 3: Working with Data: Analysis and Software
Sunday, October 16, 2016 | 1:00 - 5:00 PM

Early Career Raptor Research Skills Courses

The RRF Early Career Raptor Research (ECRR) Committee will be hosting a day of raptor research skills short-courses for ECRRs at the annual meeting in Cape May, NJ on Sunday, October 16, 2016. Classes will only be available to students and early career professionals (<3 years post-graduation). Contact the ECRR Committee Chair if you have questions on these courses. Classes will be taught by leading experts and will focus on hands-on, skill-building that is typically not available in traditional undergraduate or graduate classes. See the registration desk for location and addtional details.

Raptor Trapping at Cape May: Setup and Operation of a Trapping Station for Migrating Raptors
8:00 AM - 12:00 PM & 1:00 - 5:00 PM
Instructor: Paul Napier, Cape May Raptor Banding Project

Raptor Trapping and Handling Techniques for Scientific Research
10:00 AM - 12:00 PM
Instructor: Pete Bloom, Western Foundation of Vertebrate Zoology

Harnessing Raptors with Transmitters
8:00 AM - 12:00 PM & 1:00 - 5:00 PM
Instructors: Steve Lewis and Brian Millsap, U.S. Fish and Wildlife Service

Safely Accessing Raptor Nests
8:30 AM - 12:00 PM & 1:00 - 4:30 PM
Instructor: Joel Pagel, U.S. Fish and Wildlife Service

Techniques for Handling, Auxiliary Marking, Measuring, and Blood Sampling Raptors after Capture
1:00 - 5:00 PM
Instructors: Dan Varland, Coastal Raptors and John Smallwood, Montclair State University

Raptor Necropsy Workshop
8:00 AM - 12:00 PM
Instructor: Erica Miller, New Jersey Fish and Wildlife, Tri-State Bird Rescue & Research, and University of Pennsylvania

Raptor field & in-hand ID, ageing & sexing, recent taxonomic changes in raptors, molt and its use in ageing
8:00 AM - 4:00 PM
Instructor: Bill Clark, raptor specialist and field guide author

Plenary Speakers

Plenary speakers are scheduled for each morning of the conference.

- Monday, October 17: Ian Newton followed by a joint plenary by J. Parrish, R. Clark, and D. Bird
- Tuesday October 18: Carol McIntyre followed by a plenary panel on Women in Raptor Research
- Wednesday October 19: Yossi Leshem

IAN NEWTON
"Fifty Years of Raptor Research"

Plenary Description

This talk will pick out some of the major advances that have occurred in our knowledge and understanding of raptor populations over the past half-century. Emphasis will the placed on the factors that influence population levels, the effects of toxic chemicals, and migration studies.

About the Speaker

Dr. Ian Newton earned a Ph.D. at Oxford University under the tutelage of David Lack. He has been interested in birds since his childhood. As a teenager he became particularly fascinated by finches, and undertook doctoral and post-doctoral studies on them. His interest in that group has continued to the present time. Beginning in the 1970s, Dr. Newton conducted extensive research on the long-term impacts of organochlorine pesticides on several raptor species, and on the population ecology of the Eurasian Sharrowhawk. His 30-year study of a Eurasian Sparrowhawk population nesting in southern Scotland has resulted in what many consider to be the most detailed and longest-running study of any population of birds of prey. In 1979, he produced the classic book, "Population Ecology of Raptors," and a comprehensive monograph on the Eurasian Sparrowhawk followed in 1986. Dr. Newton's research in avian population ecology focuses on the factors that limit bird numbers and distributions, including pesticide impacts. From 1989-2000, Ian headed the Avian Biology Section at the Monks Wood Research Station, and has continued his research on raptors since his "retirement" in 2000. He has authored, or co-authored, 13 books, published over 300 technical papers, and made frequent television and radio appearances. He has served as President of the British Ornithologists' Union and the British Ecological Society, as Chairman of the Royal Society for the Protection of Birds in the United Kingdom, and of The Peregrine Fund in the United States. He is the current Chairman of the British Trust for Ornithology. Dr. Newton has received numerous awards, including Order of the British Empire, the Union Medal and Goodman-Salvin Medal of the British Ornithologists' Union, and the Elliot Coues Award of the American Ornithologists' Union.

Jimmie Parrish, Richard Clark, and David Bird
"The Raptor Research Foundation, Inc.; Promoting Understanding, Appreciation, and Conservation of Birds of Prey for Over 50 Years"

Plenary Description

Combining extensive archive research with written and oral history, the fascinating story is told of how a few individuals, with a dedication and inexhaustible interest in "hawks," began the Raptor Research Foundation. Incorporated in South Dakota in 1966, the Foundation's membership ranks have included a large number of the world's experts on all aspects of raptor ecology and management. The contributions of falconers to the Foundation and to raptor conservation biology in North America and elsewhere are well documented, and in many cases

they have been responsible for implementing legal protection and appreciation of the role of raptors in the natural world. We will present the early history of the organization dating back to the mid-1950's, the organization's formal incorporation in the mid-1960's, its formative and reformative years, international expansion and growth, and concluding with the Foundation's substantial and ongoing contributions to the ecology, conservation and management of raptors worldwide. What began as a regional effort by falconers to breed raptors in captivity to save species from extinction, the Raptor Research Foundation has now become the source for information on raptors and the only organization of its kind in North America. The Foundation's history is to be published by the Nuttall Group at Harvard University in an upcoming volume of their series entitled Contributions to the History of North American Ornithology.

CAROL MCINTYRE
"The Importance of Long-term Raptor Ecology Studies: A View From the Far North"

Plenary Description
Long-term raptor ecology studies are becoming increasingly important for measuring the responses of raptors to rapidly changing environments and environmental conditions. In this talk, Carol McIntyre will explore some of the many ways that long-term studies are expanding and enhancing our understanding of raptor ecology and raptor conservation. Carol will focus her talk on studies conducted in northern latitudes, a region that is undergoing rapid environmental change due to a warming climate, and where she has studied Golden Eagle ecology for nearly 30 years.

About the Speaker


Dr. Carol McIntyre is a Wildlife Biologist with Denali National Park and Preserve, Alaska. After working on raptor migration studies in Cape May, New Jersey and Eilat, Israel, Carol headed to Alaska in 1985 to study Peregrine Falcons along the upper Yukon River. She began studying Golden Eagles in Denali in 1987. Carol received her B.S. from East Stroudsburg University, her M.S. in Wildlife Management from University of Alaska – Fairbanks, and her Ph.D. from Oregon State University. She has published results of her studies in scientific journals, co-authored the Birds of North American Species Account for Golden Eagles and the book "Birds of Denali." Carol's research interests focus on the factors that constrain survival and reproductive success of northern breeding raptors and owls. This includes gaining a better understanding of how northern breeding raptors respond to changes on their breeding grounds, migration corridors, and wintering areas, and how they will respond to the cascading effects of climate change. Carol is an associate editor for the Journal of Raptor Research, serves on the Alaska Raptor Group steering committee, and is a network partner of the Tundra Conservation Network. When she isn't in the field studying birds, she lives in the boreal forest near Fairbanks, Alaska with her husband and their small team of very large Alaska huskies.

Laurie Goodrich, Pat Kennedy, Karen Steenhof, Joan Morrison, Jemima Parry-Jones
Moderated by Rebecca McCabe and Katie Harrington
"Women in Raptor Research: Trailblazers and the Next Generation"

Plenary Description
In the early 1940s, Dr. Frances Hamerstrom led the way for women in raptor research. In this discussion, we invite several women who are leaders in raptor research to reflect on their own history in the field and provide insight to the current and next generation of women in raptor research.

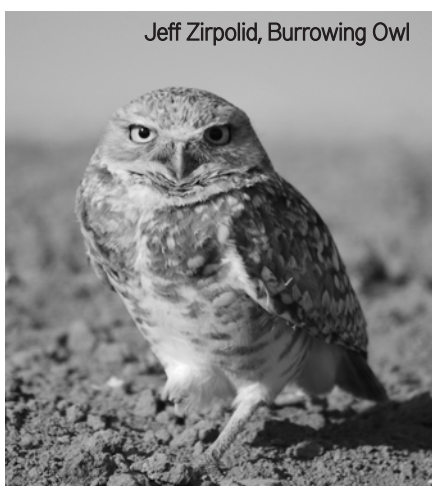
YOSSI LESHEM
"Migrating Raptors Know No Boundaries: Barn Owls as Peacemakers in the Middle East"

Plenary Description
The lecture will present four and a half decades of multi-disciplinary activities integrating research, nature conservation, education and regional cooperation in one of the most important bottlenecks worldwide for the migration of raptors and other species. One of the topics presented will be the research that resulted in the reduction of bird-aircraft collisions by 76% in Israel, saving the national budget $1.3 billion and the lives of pilots and birds. The lecture will also describe how the public, senior decision makers, Chief of General Staff and his General Staff, and the formal educational system became deeply involved in the activities, and how the Barn Owl switched the dove as the symbol of peace in the Middle East.

About the Speaker


Dr. Yossi Leshem is the most well-known ornithologist in Israel. Yossi worked at the Society for the Protection of Nature in Israel (SPNI) since 1971, the leading NGO in Israel, was the CEO between 1991-1995, and acted as the SPNI council chairman till 2011. Yossi is a staff member in the Department of Zoology in the Faculty of Life Sciences at Tel Aviv University and is the founder and Director of the International Center for the Study of Bird Migration at Latrun, Israel. Yossi is involved in many aspects of nature conservation, with emphasis on bird research for over 40 years. His research for his doctorate, which was conducted in cooperation with the Israeli Air Force, has resulted in a decrease of 76% in the number of collisions and has saved over one billion dollars, not to mention the numbers of lives. Yossi flew 272 days with a motorized glider, wingtip to wingtip with millions of birds, to map the migration over Israel. He serves as Lt. Col. (Ret.) in the Israeli Air Force and continues this research. In 2005 he won the prestigious Mike Kuhring Prize for achievements of high significance for improved flight safety concerning the bird problems of aviation, and for his mission to connect safety with nature conservation via education that gave bird strike prevention world wide appreciation. Until recently he was a member of the steering committee of the International Bird Strike Committee (IBSC). Leshem is involved in a variety of activities in bird migration research, in educational activities that take place in over 350 schools in Israel part of the cooperation with the Palestinians and the Jordanians, and has developed an Internet educational and scientific site (www.birds.org.il) called "Migrating Birds Know No Boundaries". Yossi led several projects of using Barn Owls and Kestrels as biological pest control agents in agriculture in Israel, Jordan and Palestinian Authority which became a success story even in tense periods. Leshem is a recipient of the "Lifetime Achievement Award for Environmental Protection" in 2008, awarded during the sixty years events of the State of Israel by the President and the Minister of the Environment, and in 2012 was awarded the prestigious Bruno H. Schubert Award (first place) in Germany. Leshem has published four books, scientific papers, and hundreds of articles in popular magazines.

Aaron Winters, Snowy Owl



Jeff Zirpolid, Burrowing Owl

General Session Abstracts

FROM VICTIM TO AMBASSADOR: RAPTOR REHABILITATION, OUTREACH, AND EDUCATION

*LORI R. ARENT (arent@umn.edu), The Raptor Center, University of Minnesota College of Veterinary Medicine, St. Paul, MN, U.S.A.

Over the past few decades, the increased intersection of raptors and anthropogenic landscape change has resulted in an increase in raptor injury, intoxication, disease, and in some cases, unnecessary human intervention. The close proximity of raptors to humans has also fueled community interest, intensifying fascination and compassion for these charismatic apex predators. As a result, the fields of raptor rehabilitation and public outreach have grown; a growth permitted by state and federal regulatory agencies. To increase professionalism of these fields and meet animal welfare standards, criteria for permit issuance have been established by many states. In addition, professional K-12 and adult education curriculums have been developed and are currently being expanded. This presentation will describe components of raptor rehabilitation in the urban United States, research initiatives stemming from data collection, strategies and methodologies for educating the public, and directions these fields may take in the future.

The Influence of Landscape Heterogeneity on Raptor Community Assemblages and Niche Characteristics in Mixed-grass Prairie Ecosystems

*FIDEL ATUO (fidelis.atuo@okstate.edu) and TIMOTHY O'CONNELL, Oklahoma State University, Stillwater, OK, U.S.A.

Ecological principles predict that community interactions in heterogeneous landscapes will differ significantly from those that occur in homogeneous landscapes. Habitat heterogeneity often benefits generalist species to the detriment of sympatric specialists. Understanding how sensitive species respond to the structural mosaic of a landscape is important in reducing negative interspecific interactions and the decline of vulnerable species in heterogeneous landscapes. In this study, we investigated the relative importance of landscape heterogeneity in the structuring of raptor community assemblages in mixed-grass prairie ecosystems. We also investigated the niche characteristics of individual raptor species within two communities to understand the role of habitat heterogeneity on species specialization. We used line transect distance sampling modified to offset detections to actual locations to sample for raptors at two Wildlife Management Areas (WMAs). Raptor assemblages at our two study sites were similar in community composition, but differed greatly in niche characteristics. Raptor assemblages were better explained by landscape composition variables at high heterogeneity, and better explained by landscape configuration variables at low heterogeneity. Niche positions were also influenced by the structural complexity of the landscapes. Our Outlying Mean Index analysis showed that six (43%) of the 14 raptors at Beaver River WMA (where heterogeneity was low), demonstrated marginal niches and narrower niche breadth occupying distinct land cover types. On the contrary, none of the species examined at the Packsaddle WMA (higher heterogeneity) demonstrated habitat marginality, but instead had broader niche breadths. Our study provides evidence that landscape heterogeneity is important in structuring raptor species distribution and possible community coexistence in mixed-grassed prairie ecosystems. Specifically, broad overlap occurs at high heterogeneity but occurs less so in landscapes with larger patches of distinct land cover types.

MERCURY CONTAMINATION TRENDS IN PEREGRINE FALCON FEATHERS IN COASTAL WASHINGTON

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We documented concentrations of total mercury (THg) in feathers of 153 Peregrine Falcons (Falco peregrinus) captured and color banded between 2001 and 2016 on the outer coast of Washington. Most individuals were captured on beaches during nonbreeding seasons, with breeding and natal areas generally undetermined. We captured 23 individuals more than once (1–6 recaptures with a mean of 2.9 captures per recaptured individual) to obtain feather samples from subsequent molts, with up to 11 yrs between first and last capture. All peregrines had detectable levels of THg (range = 0.7–69.83 ppm). Feathers from hatch year (HY) plumage yielded lower THg concentrations (mean = 5.81 ppm; n = 126) than either second year (SY; mean = 22.15 ppm; n = 29) or after second year (mean = 23.83 ppm; n = 29) feathers. Mean THg concentrations were not different by sex within age class. Pooling years of when feathers were grown, we found mean THg concentrations in HY peregrines were lower in more recent years (2011–2015 = 4.14 ppm; n = 40) than either the early (2000–2005 = 6.23 ppm; n = 44) or middle (2006–2010 = 6.95 ppm; n = 42) portions of our study. All recaptured

individuals except one exhibited an increase in THg after their first capture (mean increase within individuals = 24.49 ppm), with the increase from the HY to SY plumage (mean increase = 19.26 ppm; n = 16) generally showing the largest increase between sequential years. Our 16-year study illustrates widespread contamination of THg in peregrines captured in coastal Washington, with evidence of bioaccumulation within individuals and between age class, however the uptake of THg in HY peregrines showed a declining trend in recent years.

Preferred Roost Sites of Overwintering Northern Saw-whet Owls (Aegolius acadicus) in Southeastern New York State

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We observed Northern Saw-whet Owls, found by visual search and by radio telemetry, during migration and overwintering periods in suburban and urban areas of southeastern New York State. This report summarizes the vegetation, habitat, and height where the Saw-whet Owls were located during these studies

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From Mimeographed "Raptor Research News" to a Vanguard of Science and Conservation: A History of the Journal of Raptor Research

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The Journal of Raptor Research began as a newsletter entitled "Raptor Research News" first published in 1967 by the newly-formed Raptor Research Foundation, Inc. (RRF) to facilitate information exchange among persons interested in any aspect of "research on raptors." A year's subscription cost $1.00. The original editors were Don Hunter, an attorney and falconer, and Byron Harrell, a professor at the University of South Dakota. The first five volumes could be characterized as a mimeographed newsletter. The first research article with citations appeared in the second issue; "Peregrines and Pesticides in Alaska" by T.J. Cade, C.M. White, and J.R. Haugh (1967). In 1972 under the editorship of Richard "Butch" Olendorff, the name was changed to "Raptor Research," the periodical was upgraded to an abstracted journal publishing original and refereed scientific papers, and it sported a green cover with the traditional RRF Prairie Falcon logo. Another upgrade occurred in 1987 under editor Jimmie Parrish when Allen Press took over production, the title changed to "The Journal of Raptor Research" (JRR), and issues were packaged in a sandy-fawn colored cover. Subsequent editors adopted further improvements including a sage-green cover with a color painting of a raptor featured in at least one article within that issue (2000). Over the 50-year publication period, JRR articles have addressed many topics from paleontology to the ecology of predatory passerines, but have been dominated by studies on diet, breeding biology, and population ecology. In the past 10 years, JRR has moved toward more electronic access and a digital work platform. In 2008, JRR scanned and posted all articles from 1967 – 2005 on SORA. JRR also joined BioOne, a journal aggregation service allowing online subscription access to JRR for issues from 2006 to the current issue. In 2012, JRR switched to an online submission and peer-review system (PeerTrack).

Ospreys (Pandion haliaetus) in the 21st Century Suburban Landscape.

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Since the 1972 ban on DDT in the United States (U.S.), Osprey populations have increased to levels higher than the pre-DDT era, and have expanded their range substantially across the whole continent. There are now records of successful or attempted breeding in all of the lower 48 U.S. states. Much of this population growth is explained by a long-standing benign relationship with humans resulting in far less persecution than the species has experienced in other parts of its range, and active management in the form of reintroduction projects and the provisioning of artificial nest platforms. The provisioning of nest platforms has been both intentional and unintentional. Cell tower antennas provide an apparently irresistible nesting substrate for Ospreys. There are likely more than 1,000 cell towers with Osprey nests in Florida alone. In southeastern New England and Long Island, NY, roughly 95% of all Osprey nests are on anthropogenic structures. The Osprey's preference for human-made structures brings with it a substantial burden for managing the species both when nests are constructed in inappropriate, often dangerous situations, as well as when maintaining nesting platforms provided for the species.

Urban Raptors: an Ancient Run-up to a Lengthy History of Co-habitation

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Close ecological relationships between raptors and people have brought the two entities together for a long, long time, and the history of urban raptors has been long in the making. Anthropologists suggest that more than a million years ago, proto-humans followed soaring vultures to large-mammal carcasses hoping to acquire food, just as jackals and hyenas do today. More recently, ancient transhumant sheep and goat herders were followed in their seasonal elevational movements by vultures searching for food. Exactly when raptors began breeding in human neighborhoods is uncertain, but it probably occurred soon after houses with eaves were first built, and Lesser Kestrels (Falco naumanni) nested in their nooks and crannies. Accounts of Peregrine Falcons (Falco peregrinus), nesting in English cathedrals date back hundreds of years. Red Kites (Milvus milvus) were one of the most common of all large birds in fifteenth-century London. In the 1960s Black Kites (Milvus migrans) and White-rumped Vultures (Gyps bengalensis) nested at densities of 16 and 2.7 pairs per square km, respectively in Delhi, India. In mid-twentieth century North America, Merlins (Falco columbarius) began breeding and overwintering in western Canadian cities. More recently, Cooper's Hawks began doing the same in parts of the United States. Hooded Vultures living off human scraps in urban and exurban western The Gambia currently occur at densities of 17.5 birds per square km. We use these and other examples of co-inhabiting humans and raptors to assess the extent to which intrinsic factors such as neophobia and neophilia, and extrinsic factors such as available nutritional resources, the lack of human predation, and presence of appropriate nesting sites, have influenced urbanization in birds of prey.

Conservation and Management of Urban Raptors

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Although undocumented, the history of urban raptors likely goes back to cave dwellers sharing their cliff sites with those of cliff-dwelling raptors. More recently, various raptor species have moved into, or been surrounded by, urban habitats that they use for nesting and hunting. Raptor behavior, ecology, and food habits explain why some species adapt and inhabit urban areas and others do not. Urban settings can function as unique 'ecosystems' for many wildlife species, including raptors, and can be associated with both positive impacts (e.g. increased educational opportunities, which could lead to enhanced conservation efforts) and negative impacts (e.g. conflicts with building and structure maintenance and bird-feeding operations, attacks on humans, and increased anthropogenic sources of mortality leading to added pressure on wildlife rehabilitation facilities). In this presentation, we discuss issues concerning the management and conservation of urban raptors by focusing on three case histories: Peregrine Falcons (Falco peregrinus), Cooper's Hawks (Accipiter cooperii), and Burrowing Owls (Athene cunicularia). These three species represent different raptor groups, which have invaded (or been overcome by) an urban environment, and each presents somewhat different management challenges. The management of Peregrine Falcons challenges the owners and managers of human structures such as buildings and bridges, while Cooper's Hawks impact backyard feeders and Burrowing Owls have impacted, and been impacted by, urban development.

Managing a Kestrel Colony for Research Purposes for Forty Years --- Would I Do It All Over Again?

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In 1972 ten pairs of American Kestrels (Falco sparverius) were acquired from various sources to become the founders of a captive breeding colony to be housed at what was known as the Macdonald Raptor Research Centre (later renamed the Avian Science and Conservation Centre – ASCC) on the Macdonald Campus of McGill University in Ste. Anne de Bellevue, Quebec. Unlike the kestrel colony held at the Patuxent Wildlife Research Center in Maryland by the U.S. Fish and Wildlife Service mostly for toxicological studies (which still exists today), the McGill kestrel colony was initially established for the objective of developing alternative captive breeding techniques such as artificial insemination and forced re-nesting and to act as surrogates for endangered raptors such as Peregrine Falcons (Falco peregrinus). During the ensuing three decades, the colony was made accessible to all scientists in a wide array of research fields, including toxicology, pathology, nutrition, reproductive and basic physiology, ecology, behavior, parasitology, and genetics. To allow for comparative studies, a wild nest-box population in the immediate region was also established. During the span of 1973 to 2013, no less than 115 peer-reviewed papers were published on the American Kestrel by staff, students, and collaborators with the ASCC. A total of 27 students earned their post-graduate degrees specifically using the ASCC kestrel facility. At one point, the ASCC kestrel colony numbered almost 500 birds. The

annual cost of operating the colony was just over $100,000 CDN, giving credence to the ASCC motto --- "we do a lot for a little!". The last kestrels were shipped to Patuxent to bolster their breeding lines in 2012.

How Drones Can Be Useful for Raptor Research and Management

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Small unmanned vehicle systems (UVS; aka drones) are gaining in popularity among wildlife biologists and managers all over the world for conducting population surveys, tracking radio-tagged animals, sensing and observing animals in sequestered or dangerous places, mapping and monitoring wild habitats, and deterring poachers. This naturally includes avian species such as raptorial birds. To date, we employed a rotary UVS to record the nest contents of five raptorial bird species nesting in Saskatchewan and Montana, and monitored their respective behavioral responses. We have experimented with using a fixed-wing UVS to count the abundance of nesting water birds, to map breeding habitat of threatened birds, to detect heat signatures from small birds and their nests, to radio track birds wearing either VHF transmitters or nano-tags for MOTUS tower operations, and to disperse nuisance birds from agricultural crops. Compared to using manned light airplanes or helicopters, flying drones can be cheaper, greener, less obtrusive, and much safer (the number one source of mortality for wildlife biologists is dying in a plane or helicopter crash!). However, UVS technology is still in its infancy. Limitations exist in the form of regulations, costs, and in the technology itself, e.g. weather constraints, terrain, piloting skills, etc. This presentation summarizes the above research and discusses how this emerging technology can be used for raptor research and management.

Punctuated Equilibrium of Methods, Gradualism of Means, and Quantum Evolution of Restrictions and Responses: The Evolution of Raptor Research Methods and the Advent of Animal Welfare Concerns

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Through the practice of falconry, capture and husbandry techniques for birds of prey were developed millennia ago, have changed little in practical application since, and are widely employed by raptor researchers today. There has been a gradual change in techniques, as technological advances have provided new materials, such as monofilament, that have replaced antiquated materials, such as horsehair. In contrast, the last 50 years has seen the rapid development of legal and methodological restrictions, and a subsequent, persistent, trend in regulatory expansion, governing animal research. This applies to raptor researchers in virtually all countries with Animal Welfare Legislation, and many of the laws and constraints are similar among countries. Raptor biologists, largely dependent on tried and true methods, can be constrained by guidelines and restrictions developed for agriculture and laboratory research, and not intended for field research or research involving wild animals. Although some individuals have attempted to continue their practices as they always have, the raptor research community in general has taken a positive response to animal welfare concerns. Efforts have been made to develop alternative capture and care methods, such as modification of trap construction to better protect lure animals, or have attempted to develop models in place of live lure animals. Additional efforts have been undertaken to work with animal care and use committees to promote better communication and understanding of raptor research methods. Foundational to this, is recognizing and understanding the shifting societal perspectives leading to animal welfare concerns, and our need to adhere to accepted procedures and oversights to minimize criticism and further regulatory expansion, and to legitimize our research methods in the eyes of society.

The Influence of Size, Habitat, and Diet on Urban Raptor Communities

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Birds of prey are becoming common as permanent and seasonal residents of urban settings. Numerous studies have focused on ecology, productivity, habitat use, and survival of raptors in urban settings, but these are frequently single species studies. In contrast, few studies have examined raptor communities, even under non-urban conditions. Several factors may explain how the structure of a given urban ecosystem may influence the composition of urban raptor communities, including raptor size, habitat preferences, and prey use. Smaller or diurnal raptors may avoid urban areas that favor larger or nocturnal raptors. Some cities may provide tall buildings that facilitate occupancy by cliff nesting raptors, or urban woodlands that attract forest raptors, or both. Latitude and location may also influence raptor presence; bird hunting raptors may find abundant prey resources in urban settings at higher latitudes, whereas reptile specialists may not. I will present a taxonomy-based assessment of which raptor species

regularly occupy urban areas compared to those that do not, and examine these patterns on bases of raptor body size, habitat use, food habits, and what can be gleaned from the literature regarding behavioral plasticity and intra- and inter-specific tolerances.

Breeding Biology of Globally Threatened Red-Footed Falcons (Falco vespertinus) in Unmanaged Forest-Steppe at a Nature Reserve in North-Central Kazakhstan

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The Red-footed Falcon is a globally threatened long distance migrant that breeds in forest-steppe habitats from Hungary to central Siberia. The little published data on its breeding biology are from managed nesting colonies in heavily agricultural settings in Europe. We evaluated 19 years of Red-footed Falcon breeding data collected in unmanaged forest-steppe habitats in Kazakhstan, to understand behavioral and inter-annual correlates of reproductive output. Preliminary analyses indicated Red-footed Falcons arrived annually in northern Kazakhstan in early May; mean lay date was 02 June (±1.07 days (±SE); range: 12 May – 27 June), mean hatch date was 30 June (±1.10 days; 09 June – 26 July), and mean fledge date was 25 July (±1.23 days; 11 July – 23 August). Lay date varied annually ($p < 0.0001$), and falcons that used nest boxes laid eggs earlier than those in natural nest sites ($p = 0.0001$). However, we detected no effect on lay date of habitat vegetation type. Red-footed Falcons laid 3.49 eggs per nest (±0.07; range = 1 – 6) and produced 2.93 chicks (±0.10; range = 1 - 5) and 2.35 fledglings (±0.09; range = 1 – 5). Numbers of eggs, chicks and fledglings did not vary from year to year, and were not influenced by nest type. Although numbers of eggs and chicks did not vary with nesting habitat type, numbers of fledglings were greater in forest interior than in forest edges. Finally, lay date had a strong influence on production of eggs ($p = 0.0014$), chicks ($p = 0.0018$) and fledglings ($p = 0.0134$). These preliminary data suggest that factors such as weather and breeding experience may combine with nesting habitat to influence reproductive biology of this poorly known species.

Rise and Fall of Northern Goshawks (Accipiter gentillis) in the Central Appalachian Mountains: Is There Reason for Conservation Concern in the Northeastern U.S.?

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Autumn counts of dispersing Northern Goshawks at two Pennsylvania hawk watches, Hawk Mountain and Waggoner's Gap, increased from 1990 through 2001 and then declined significantly through 2015 to levels lower than the early 1990s. During the period from 1975 to 2015, at both locations, the lowest five counts occurred during the past 10 years. Counts at both stations during the autumn of 2015 were the lowest during the past 40 years. In the past 25 years breeding Northern Goshawks expanded into West Virginia and Maryland and then retreated from both states to central Pennsylvania and northward. The states of Pennsylvania, New York, Massachusetts, and Vermont documented declines in Northern Goshawk breeding between first and second state-wide breeding bird atlases. Average reproductive success in the central Appalachians between 2001 and 2015 was 58 percent, although in both 2009 and 2015 reproductive success fell below 20 percent. Turnover of females in breeding territories is twice that of males, and at monitored territories two nesting females have been found depredated by mammalian predators. Inflection of population trend trajectory in central Appalachian Northern Goshawks occurred between 2000 and 2002 as West Nile Virus spread across the eastern U.S. Since 2000, Fisher (Pekania penanti) populations have increased dramatically in central Appalachian mountain states. Northern Goshawk populations in the central Appalachians may be experiencing demographic challenges resulting from addition of these two new mortality factors. Northern Goshawk populations in the central Appalachians, and possibly the northeastern U.S., may be at the point where additional conservation and research attention is warranted.

An Overview of 25 Years of Northern Saw-whet Owl (Aegolius acadicus) Migration Banding in the Mid-Atlantic and Central Appalachians

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Beginning with Assateague Island in 1991, and expanding to Casselman River in 1992, Lambs Knoll Maryland in 1996 and in 1998, and recent banding stations in Pennsylvania, there is now relatively long time-series data

set from constant-effort migrant Northern Saw-whet Owl banding stations available for population trend analysis. In the central Appalachian and mid-Atlantic states, Northern Saw-whet Owls exhibit a cyclical trend with relatively large movements approximately every four to five years. Peaks occurred in 1995, 1999, 2007, and 2012. The autumn of 2003 was notable for its lack of the anticipated characteristic peak Northern Saw-whet Owl movement. Peak years are characterized by large numbers of juvenile owls reflecting high breeding success in northern and boreal forest regions of the eastern United States and Canada. During migration, age class composition varies gradually from the Atlantic coast, where juveniles predominate, to the Appalachian Mountains where age ratios are nearly equal. Effort-corrected capture rates also increase from the coast westward to the Appalachian Mountains. Using data from banding stations with long-term data sets, effort-corrected banding results will be used as an index to assess population trends. These data will also be used evaluate changes in migration phenology over time to test for possible changes in migration phenology.

Observations on the Second Pre-basic Molt of Known-Age Snowy Owls (Bubo scandiacus) and Identification of Second Winter compared to Older Individuals

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More than 500 juvenile Snowy Owls banded during the winter of 2013-2014 provide a substantial cohort of marked known-age individuals for subsequent recapture. A sample of the surviving banded Snowy Owls that migrated south during the following two winters was recaptured by banders participating in Project SNOWstorm. Plumage notes and wing photos were collected from recaptured Snowy Owls following Project SNOWstorm's cooperative banding protocol. Pyle's Identification Guide to North American Birds indicates that there is no, or very limited (P7), replacement of primary flight feathers during the second pre-basic molt and that only a small number of inner secondary flight feathers are replaced during the second pre-basic molt. A limited second pre-basic molt was also described by Solheim from museum specimens. Our observations of second pre-basic molt collected from known-age owls will be summarized, the range of variation in molted feathers will be presented, and these data will be compared to Pyle's age criteria and Solheim's "M1" and "M2" molts. Our observations from known-age individuals indicate that the second pre-basic molt in Snowy Owls replaces from one to four primary flight feathers from one molt center (P7) and from five to fifteen secondary flight feathers at up to three molt centers (S2, S5 and S13). Solheim's M1 and M2 molts represent the extremes of the second pre-basic molt and not two separate molts. Criteria for separating second year from third year individuals from older individuals will be provided to facilitate more accurate ageing of second year and third year Snowy Owls.

Continental-scale Movements of Golden Eagles in Western North America

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Efficient landscape-scale conservation of highly mobile species requires understanding their use of space throughout their life cycle, including when they are migrating, dispersing from breeding or natal locations, or otherwise not engaged in breeding activities. We assessed the movement patterns of over 600 Golden Eagles (Aquila chrysaetos) tracked using satellite telemetry from 1992 through 2016. Our data set included individuals of both sexes, all age-classes, and various reproductive states. In general, migration and movement behaviors were diverse

and sometimes difficult to characterize or predict. Many individuals that spent summers north of approximately 52° N migrated south for the winter by moving along the front range of the Rocky Mountains. However, other migratory Golden Eagles traveled along other ranges west of the Rockies, or even across non-mountainous central Canada. Individuals that summered in the lower 48 states, especially sub-adults that were not yet breeding, often established different home ranges for summer and winter, and sometimes when migrating stopped along the way for weeks at a time. Yet other Golden Eagles, even when pre-reproductive, remained in the same home range throughout the year. Many of these highly sedentary individuals appeared to live in areas with high availability of prey year-round. Although Golden Eagles concentrated movements along the eastern slope of the Rocky Mountains from Alaska through Canada and into Wyoming and Colorado when moving through those regions, our analyses highlighted the tremendous diversity of movements and identified other important migration corridors and non-breeding areas. We suggest that anthropogenic activities that may harm Golden Eagles undergo particular scrutiny in regions of concentrated use by Golden Eagles as these areas may impact a disproportionately large fraction of the western continental population.

History and Status of the World's Most Widely Distributed Bird

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The Peregrine Falcon (Falco peregrinus) has the world's largest distribution of any bird, breeding on every continent except Antarctica and on many coastal and some oceanic islands. It is nevertheless absent from some areas where habitat and its avian prey appear favorable. Peregrines use the same nesting sites (eyries) continually for decades, even centuries, and are noted for the stability of their breeding populations, as lost nesters are quickly replaced by non-breeding adults (floaters), even in the face of persistent human persecution. It therefore came as a distinct surprise in the 1950s and 60s when Peregrines disappeared from their historical eyries, first noted in Great Britain and then in North America, continental Europe, and elsewhere. It was soon discovered that organochlorine pesticides (DDT, dieldrin) acquired from contaminated prey were responsible. Entire populations were greatly reduced or extirpated, particularly in the Northern Hemisphere. Recovery came about between 1975 and 2000 by securing government restrictions on the use of pesticides (EDF and others), providing full protection to the surviving falcons (ESA, CITES), and by captive breeding and the reintroduction of >10,000 progeny. Although Peregrines have not yet fully recovered in parts of their historical range, in other regions they are now more numerous than before and are increasing. Moreover, the falcons are nesting frequently in urban, metropolitan, and industrial landscapes on man-made structures they seldom used in the past, commonly in big cities such as London, Berlin, and New York. Even though some parts of the former breeding range may never be reclaimed, it may be that there are more Peregrine Falcons in the world today than before the pesticides-induced decline, especially if all the captive bred falcons are counted. We must now look to the environmental impacts of climate change to gauge the future of this remarkably adaptable species.

Simulated Detection of Golden Eagle (Aquila chrysaetos) Passage During Fall Migration Using Historical Count Site Data: Assessment of Recommended Survey Protocols

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Land-based wind energy facilities present a risk to raptor species migrating or foraging in close proximity to wind turbines. United States Fish and Wildlife Service (USFWS) Eagle Conservation Plan Guidance for wind energy development provides basic guidelines on the performance of point count and fall migration count surveys prior to the construction of new wind farms in Golden Eagle habitat to assess use of the site by Golden Eagles. As measured at HawkWatch International count sites across western North America, Golden Eagle passage on fall migration is highly variable both spatially (between sites) and temporally (within and across years). Using data collected from 1980 to the present at six count sites in the Intermountain, Pacific, and Rocky Mountain flyways, we assessed the recommended guidelines put forth by the USFWS by performing random, repeated subsampling to imitate the recommended survey protocol. We evaluated differences observed between each count site's total historic mean passage rate for Golden Eagles and the detected passage rate for each site's set of simulated surveys. We then evaluated the recommended USFWS survey protocol after assessing the differences in 'total' versus 'detected' eagle passage rates for each migration count site in our data set. Based on our results, we provide specific Golden Eagle survey recommendations applicable to the USFWS Eagle Conservation Plan Guidance document.

What do we Know About the Short-eared Owl (Asio flammeus) from its Literature Worldwide?

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The Short-eared Owl is one of the most widely distributed owl species in the world. Despite that fact, it is not one of the most widely known species, and there are indications that populations are declining in certain parts of the World. The reasons for this are suspected, but not well documented; thus, mechanisms for reversing these declines are yet to be determined. From a bibliography of > 1600 references, the collection of articles has been and continues to be acquired. From the keywording and cross-referencing of the contents of these references, certain needs for research have been elucidated. There have been numerous geographic races or subspecies identified; e.g., eight to eleven with two subspecies being suggested as merging with others and one perhaps warranting species status. The use of the mitochondrial cytochrome c oxidase subunit I (COI) gene is considered a powerful molecular identification tool for 'barcoding' populations, and has been utilized preliminarily in comparing Short-eared Owl individuals from South America to those of northern North America, Europe, and northern Asia. Evaluated individuals were found to be highly divergent between these locales. Another molecular tool that may assist in answering basic questions about the extent to which this species is resident, migratory, or nomadic in a particular part of the world is stable isotope analysis to examine the spatial origins of individual Short-eared Owls. Stable isotope analysis has already been applied, on a limited basis, to this species. Habitat loss has been ascribed to this species' population decline in certain regions. Large-scale characterization of habitats and the application of habitat management on a landscape level with some modification of agricultural methods might be an effective way to reverse these losses of suitable habitats.

Contrasting Molecular and Morphological Evidence for the Identification of an Anomolous Buteo: A Cautionary Tale for Hybrid Diagnosis

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An adult Buteo was found dead as a road-kill south of Sacramento, California, and was thought to represent the first state record of the eastern Red-shouldered Hawk (B. lineatus lineatus). The carcass is now a specimen in the Museum of Wildlife and Fisheries Biology (WFB 4816) at the University of California, Davis. We examined this specimen and found that many of its plumage characters differed from all other adult Red-shouldered Hawks examined, including nominate adults. Plumage markings and measurements were intermediate between Red-tailed Hawk (Buteo jamaicensis, ssp calurus) and Red-shouldered Hawk (ssp elegans), leading us to hypothesize that the bird was a hybrid. However, mtDNA sequences and nuDNA microsatellites proved definitively that the bird was a Red-shouldered Hawk, most likely of eastern origin. This case illustrates that apparent hybrids or apparent vagrants could be individuals with anomalous phenotypes caused by rare genetic variation or novel epigenetic effects.

Species Composition, Timing, and Meteorological Correlates of Autumn Open-water Crossings by Raptors Migrating Along the East-Asian Oceanic Flyway

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Raptor migration rarely involves long-distance movements across open-oceans. One exception occurs along the East-Asian Oceanic Flyway. We collected migration data at two terrestrial hawk watch sites along this flyway to better understand open-ocean movements along this largely overwater corridor. At the northern end of the Philippines, at Basco on the island of Batan, we recorded 7,587 migratory raptors in autumn 2014. Near the southern end of the Philippines, at Cape San Agustin on the island of Mindanao, we recorded 27,399 raptors migrating in autumn 2012. Chinese Sparrowhawks (Accipiter soloensis) were the most common species observed, comprising approximately 89%

and 92% of total records for Basco and Cape San Agustin, respectively. The Grey-faced Buzzard (Butastur indicus) was the second most common raptor migrant, accounting for 8% of the total counts at both watch sites. The rate of migration passage at both sites was highest on cloudy days when winds were blowing from the northwest. That said, Accipiter passage increased with headwinds. Identification of the magnitudes of the flights, together with correlates of migration behavior along the East-Asian Oceanic Flyway helps to characterize poorly known aspects of raptor biology and to identify potential migratory bottlenecks or key sites for raptor conservation in little-studied tropical ecosystems such as the Philippine archipelago.

Powerful Owls: The Journey so far

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The Powerful Owl (Ninox strenua) is Australia's largest and most charismatic owl, with research spanning many decades. Historically this species was perceived as being confined to old growth forests, primarily due to specialist diet and breeding resources. More recently, Powerful Owls have been detected residing, and in some instances, breeding in urban environments. Their presence in urban environments has refocused our research and made us question their reliance on old growth environments. For the last two decades we have investigated the ecological attributes of Powerful Owls, and implemented different technologies to gain an in-depth understanding of this species across a gradient of urbanization. Our initial research focused primarily on understanding the basic ecological traits of this species in urban areas, specifically diet, roost, and nest tree characteristics in relation to breeding success. Once we had a grasp of these basics we turned our attention to modern technologies and are currently incorporating DNA profiling, spatial modeling and GPS tracking to further extend our knowledge of Powerful Owls. Using these techniques, we are, for the first time, able to obtain information about the mating and breeding habits, natal and territory size, and habitat use of urban Powerful Owls. This information will be critical for the future management of Powerful Owls in urban environments, especially in light of a rapidly changing environment.

The Response of Raptors to an Increasingly Urbanized World

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As urbanization continues to expand globally, it is paramount that research shifts its focus towards urban ecosystems, particularly the effect that severe landscape change is having on biodiversity at both species and community levels. Impacts of urbanization have been described as catastrophic for many species. Top-order predators are often among the first species to disappear when subjected to large-scale change, as they generally possess specialist traits and requirements not supported by urbanizing environments. Raptors are no exception to this, with many species unable to adjust and survive in highly disturbed urban ecosystems. Some raptor species, however, have adapted to the urban environment to the point that they exist at higher densities and have higher fecundity than their forest counterparts. Ecological factors influencing their urban survival appear universal, and relate primarily to resilience and adaptability in relation to prey, breeding requirements, and habitat use. An obvious question is what constitutes habitat for raptors in urbanized landscapes, how is habitat distributed and what facilitates movement through the landscape? Identifying key habitat characteristics is not easy, and increasingly relies on modern technologies, including spatial modeling, species distribution modeling, and gene flow modeling to help identify the key characteristics influencing when raptors successfully inhabit and thrive in urban ecosystems.

Hawks, Owls and Wildlife Revisited: Long-term Trends in a Raptor Community

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In the late 1940's, John and Frank Craighead surveyed an area for nesting raptors in Jackson Hole, Wyoming. Their work resulted in the book, "Hawks, Owls and Wildlife" which is still considered a definitive text on raptor ecology. The

initial study was multi-faceted, focusing on the evaluation of species richness, density of nesting raptors, estimation of lay dates, clutch sizes, nest locations, territory and nest fidelity, and a host of other aspects of raptor ecology. The area has been surveyed multiple times since the 1940's, including during the 2014 and 2015 nesting seasons. Since the initial study, we have documented a similar nesting density of all raptors, but fewer Red-tailed Hawks (Buteo jamaicensis) and Swainson's Hawks (Buteo swainsoni), and many more Common Ravens (Corvus corax). In the most recent surveys, we did not detect any Long-eared Owls (Asio otus) or Western Screech Owls (Megascops kennicottii), both of which had been detected in previous surveys. In 2014 however, we did find the first known nesting Peregrine Falcon (Falco peregrinus) in the study area. The American Kestrel (Falco sparverius) was the second-most common species in the initial study (second to Red-tailed Hawks), and is now the most common nesting raptor in the study area. Nesting season chronology for all detected raptors was approximately the same over time, as were clutch sizes. We will discuss causes for the documented changes in the raptor community, and compare trends found in our study area with broader documented trends of raptors in Western North America.

Migration Routes of Peregrine Falcons Along the Atlantic Flyway, and Perspectives on use of Mid-Atlantic Wind Energy Areas

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Peregrine Falcons (Falco peregrinus; hereafter Peregrines) have 'pelagic' tendencies that increase their probability of encountering offshore wind energy facilities, including those being considered for construction along the Atlantic Flyway. The Mid-Atlantic Study Area (MSA) holds Delaware, Maryland and Virginia Wind Energy Areas (WEAs), and is of particular interest for future development of offshore wind energy facilities. We fitted 24 migrant Peregrines with satellite transmitters in Maine (2010) and Rhode Island (2012-2015) to characterize Peregrine migration routes along the Atlantic Flyway, and to evaluate Peregrine's space use relative to offshore WEAs in the MSA. Peregrine migration routes were more concentrated and closer to shore in the northern portion of the U.S. Atlantic Flyway (RI to NC) compared to the southern portion (Cape Hatteras, NC southward). The majority of Peregrines following the Atlantic coastline initiated transoceanic flights from a 120-km stretch of shoreline between Cape Lookout and Cape Hatteras, North Carolina. Proportions of Peregrine utilization distributions (UDs) coinciding with the mid-Atlantic study area ranged widely, from 0 – 80% (mean ± 95% CI: 25 ± 11%). Twenty-one percent of southbound migrants followed the Atlantic shoreline west of the Mid-Atlantic study area. These individuals likely had minimal or no interactions with the MSA. Sixteen percent of individuals used offshore routes east of the MSA. The remaining 64% chose migration routes that overlapped at least a portion of the MSA. The extent of UD overlap with the MSA and time spent varied widely among these individuals. Limited transmitter flight altitude data suggested offshore migrant Peregrines commonly flew below, within, and above the rotor sweep zone associated with offshore wind turbines.

Urban Raptors: Perspectives and Future Directions

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The adage that "wildlife management is really people management" has never been more appropriate than today, and this is especially true for conserving and managing raptor populations in urban environments. There are at least three major related trends to consider: (1) the spread of urban-suburban areas and related infrastructure continues to grow, and remains a major driver of habitat change; (2) wildlife species continue to move into urban-suburban areas, including many species that we would not have predicted as urbanized 2-3 decades ago; and (3) human-wildlife interactions are increasingly complex; the landscape of stakeholders is increasingly diversified, and issues related to human health, safety, and tolerances are critical considerations. Foundational to our understanding is an evaluation of what we know, and what we do not know, about raptor biology, especially within the context of urban environments, which can provide rich research settings allowing a closer examination of species. For conservation, urban areas can be used or developed as habitat, or could serve as buffers to environmental change (including climate change) for some species. Stakeholder involvement from a very wide variety of interests will be critical to garner support and to avoid or mitigate conflicts. Citizen science can be deployed to enhance information gathering and to engage the public. Finally, public health and safety considerations, such as careful management of large trees and snags that are important to many raptors species or their prey, will be of the utmost importance in urban settings.

Blood Lead Levels of Fall Migrant Golden Eagles (Aquila chrysaetos) Captured in Montana

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Lead has long been documented as a serious environmental hazard to eagles and other predatory, opportunistic, and scavenging avian species. However, the degree to which lead poisoning is prevalent in eagle populations is not well understood. We analyzed blood from 178 Golden Eagles captured on fall migration in Montana from 2006 to 2012 to determine blood lead levels (BLL). Of these, 58% (n = 103) of eagles had elevated BLL (> 10 µg/dl), 10% (n = 17) were exposed at a level considered clinical (> 60 µg/dl), and 4% (n = 7) had BLL considered lethal (> 120 µg/dl). Golden Eagles captured on carrion had higher BLL than those captured using live bait, suggesting differences in BLL may be due to variations in feeding habits among individuals. Our findings suggest that migrant golden eagles in western North America are susceptible to lead poisoning during fall migration and furthermore, that scavenging behavior may lead to this problem.

The Distribution and Relative Abundance of Mexican Chicken Bugs in Golden Eagle Nests in Southwestern Idaho

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Hematophagous ectoparasites can increase the costs associated with reproduction of many raptor species. Raptor nestlings require substantial energy for growth and development, leaving little capacity to deal with health challenges caused by nest ectoparasites. Ectoparasite-induced anemia can reduce nestling mass and immunocompetence, and repeated exposure to biting insects may elicit stress responses triggering premature fledging. Insects in the family Cimicidae (Order Hemiptera) can significantly impact host species because both nymphs and adults require blood meals. One species in particular, the Mexican Chicken Bug (Haematosiphon inodora), has been shown to negatively impact nestling development, cause premature fledging, and nestling mortality in a variety of raptor species. In 1996, a new northern latitudinal distribution of Mexican Chicken Bugs was reported in the Morley Nelson Snake River Birds of Prey National Conservation Area (NCA). Our objectives were to assess the distribution and relative abundance of Mexican Chicken Bugs in Golden Eagle (Aquila chrysaetos) nests along the Snake River Canyon in the NCA. We visited Golden Eagle nests throughout the breeding season and quantified abundance using cimicid-specific traps at nest sites. We compared relative abundance of Chicken Bugs to nestling health and development and we evaluated nest site characteristics to understand the factors that may increase risk of Chicken Bug infestation. We also evaluated the use of aromatic green plant material at nest sites as a method for controlling abundance. We estimated the amount of plant material in each nest, collected samples of nest material for identification and chemical analysis, and compared the presence of aromatic green plants to ectoparasite abundance.

Resting Site Selection by Golden Eagles (Aquila chrysaetos) Demonstrates Resource Use Driven by Flight Behavior

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Birds select resting areas that provide protection from predators or mobbing, protection from inclement weather, and opportunities for foraging. Large birds that depend on use of environmental updrafts during flight also may select resting sites that give them access to updrafts. We tested these four hypotheses by identifying drivers of resting-site selection of Golden Eagles in eastern North America. We paired resting locations of Golden Eagles with random locations and determined whether slope, aspect, land cover, topographic position, age, and interactions influenced resting-site selection. Then we separately assessed the influence of these factors on perch (daytime) and roost (nighttime) sites for winter, summer, and spring and fall migration. Preliminary analyses found little evidence to support the hypothesis that Golden Eagles selected resting sites for protection from predators or mobbing, and indicated some support for selecting resting sites for thermal protection. We found strong support that Golden Eagles chose resting sites close to where updrafts develop. These flight opportunities may also enhance foraging opportunities, although we were unable to fully assess this hypothesis due to inadequate information on prey distributions. In spite

of the substantial seasonal variation in landscape features associated with perching and roosting, Golden Eagles consistently appeared to balance opportunities for soaring flight with thermal protection when selecting resting sites.

City Lifestyles: Behavioral Ecology of Urban Raptors

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If there can be said to be a single unifying characteristic of urban/suburban raptors, it would be adaptability. Species that can use urban environments are adaptable in one way or another, and this flexibility has resulted in great diversity in the ways birds adjust their behaviors to use urban spaces and cohabit with people. Urban raptors use a wide variety of habitats, ranging from the almost completely urban areas used by Peregrine Falcons (Falco peregrinus) to industrial areas, urban green spaces, and low-density residential housing interspersed with pockets of native vegetation. Some urban raptor species choose novel nest sites in cities, such as billboards, window ledges, and rooftops, while others nest in planted, nonnative trees, and still others use native tree species that differ little from the trees used in rural, natural areas. Foraging behaviors of urban raptors are equally diverse. Some, like the Barn Owl (Tyto alba), which specializes on rats, take advantage of urban pests. The Cooper's Hawk (Accipiter cooperii) and other bird-hunters benefit from increased prey availability, especially at bird feeders, while scavengers such as the Black Kite (Milvus migrans) frequent urban rubbish dumps. Generalists, such as the Red-shouldered Hawk (Buteo lineatus), successfully find the same prey species taken by their rural counterparts. Some behaviors of urban raptors can generate conflict with their human neighbors. For example, urban Swainson's Hawks (Buteo swainsoni), Red-shouldered Hawks and Cooper's Hawks are less fearful of humans than are rural birds and their nest-defense behaviors sometimes include swooping at or striking pedestrians. The diversity of behaviors of the different species may be expected to lead to further adaptations to urban landscapes.

The Red-shouldered Hawk: an Urban Jack of All Trades

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Red-shouldered Hawks (Buteo lineatus) of all subspecies inhabit urban and suburban areas throughout their range in North America, from Minnesota and Ontario to Florida, and Maryland to California. But they have been studied in detail primarily in Ohio and California. Their urban/suburban habitats are more urban and less forested than those of hawks nesting in more typical rural areas, with home ranges averaging about 50% urban land-cover. Home ranges of urban birds are also smaller than those of their rural counterparts. Nonnative trees planted in urban areas provide suitable nest sites, particularly in California, where up to 57% of urban nests are in nonnative species. Urban/suburban birds are less secretive and more defensive of their nests than rural birds, and unlike most rural Red-shouldered Hawks, they strike researchers climbing to nests during approximately 11% of climbs (when nestlings are present) and also sometimes strike pedestrians on the ground. A generalist predator, the urban Red-shouldered Hawk makes use of a variety of prey, in some cases taking advantage of food sources that are more abundant in cities. However, urban living may come at a cost, as up to 67% of the mortality for which the source is known comes from anthropogenic sources such as collisions with vehicles and electrocution. Although their tolerance of humans, small home ranges, and varied diet have made Red-shouldered Hawks an urban success story, they face continued threats from suburban development, increased mortality, and use of rodenticides.

Morphological Changes in American Kestrels (Falco Sparverius) Suggest Multiple Causes Contribute To Widespread Population Declines.

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Once common across North America, the American Kestrel has experienced population declines in the last two decades. Hypotheses for the decline include mortality from West Nile Virus, anticoagulant rodenticide exposure, climate change, an increase in avian predators, habitat degradation, and reduction in food availability. We examined how morphology, specifically mass and wing chord, has changed at seven migration sites throughout North America as American Kestrel populations have declined. Although it is not clear which of these forces are causing American Kestrel declines, observed changes in morphology can help narrow the field

of potential causes. Our results show a decrease in mass at five sites and a decrease in wing chord at four sites. In contrast, American Kestrel wing chord has increased at one site. We propose that climate change, habitat degradation, reduced food availability, an increase in predators, or a combination of these factors could be causing population declines at sites with observed decreases in body size. Furthermore, both rodenticide exposure and West Nile Virus may negatively affect American Kestrel populations in some locations. By comparing predicted morphological changes due to these hypotheses with observed trends, we can rule out specific hypotheses for certain flyways. However, it is likely that different factors are causing American Kestrel populations to decline in different regions of North America. This study is the next step in understanding how and why American Kestrels are in decline, and provides future research directions for conservation of the species.

Winter Roost Selection of Short-eared Owls (Asio flammeus) in an Agriculture-dominated Landscape

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Short-eared Owls have experienced a steep decline over much of their North American range during the past half-century. Specifically, habitat loss and degradation in the wintering grounds, and in places where the owls occur year-round, are considered to be the major threat. From January through March of 2016, we located and identified 47 Short-eared Owl winter roosts in the Grand Prairie Region of Central Illinois–a landscape dominated by row-crop agriculture. We measured and collected data on microhabitat characteristics and landscape features for each roost location and compared them to an equal number of paired random locations where Short-eared Owls were not found roosting. Preliminary data analysis suggests that Short-eared Owls showed differential use of areas of predominantly Smooth Brome (Bromus inermis) and other short prairie grasses in selecting winter roost locations. Overall vegetation density at the roosts was higher than that of the random sites. Additionally, Short-eared Owl winter roost sites were located further away from roadways and edge habitats compared to random sites. We will conduct a second field season during winter 2017 to investigate the extent of site fidelity to those winter roosts located this year.

Guidelines for Evaluation and Treatment of Lead Poisoning of Wild Raptors

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Lead poisoning is a threat to birds, particularly scavenging birds of prey. With the availability of portable lead testing kits, an increasing number of field researchers are testing wild-caught birds, in situ, for lead poisoning. The purpose of this presentation is to describe guidelines for evaluation of lead toxicity in wild raptors, to outline field testing of blood-lead concentrations, present criteria for removing a lead-poisoned bird from the wild for treatment, and suggest strategies for effect treatment of lead intoxicated raptors. Field-testing of birds is most commonly accomplished via portable electrochemical analysis of blood; visual observation of condition alone may provide insufficient evidence upon which to make a decision about lead poisoning. Our intended audience is not only the avian research community, but also rehabilitation facilities that may receive apparently uninjured birds. Best practices suggest that birds whose blood-lead levels are < 40 µg/dL be released back to the wild as soon as possible after capture. The decision to release or treat birds with blood-lead levels between 40 and 60 µg/dL should be made based on the presence of clinical signs of poisoning and relevant biological characteristics (e.g., breeding status). Finally, birds whose blood-lead levels are >60 µg/dL are potentially lethally poisoned and are best served if pulled from the wild for appropriate treatment at a licensed rehabilitation facility and later released. This talk presents guidelines for decision making for treating lead poisoning of wild raptors. Future work based on experimental studies will clarify the role of lead poisoning for specific species and be important to refine these guidelines so that they can be more effective.

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50 Years of Raptor Studies in Spain

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During the last 50 yrs, studies in ecology, behavior and conservation of raptors in Spain have experienced an incredible increase, both in number and quality. Starting with the pioneers of descriptive studies about population status and conservation problems, around the 80´s a new generation of researchers started to work in ecological problems using raptors as models. This new approach was especially evident in Doñana National Park, taking advantage of one of the longest data series of raptors population in the world. During the last two decades, the number of raptors specialists has increased, including not only researchers from the Spanish Council (CSIC), but also

from some Universities where former students with senior CSIC researches started to generate their own working groups. Now, the raptor biology conducted in Spain is among the most influential in the world, being one of the most productive countries in weighted production. Last years, an apparent increment in conservation oriented science was evident. Contributions to the determination, mitigation and retrofiting of power lines, wind farms, mine pollution, etc. that resulted in changes in by-law-regulation in Spain and all over Europe and South America are among the most relevant contributions. Reintroduction programs were also successfully conducted including Osprey (Pandion haliaetus), Spanish Imperial Eagles (Aquila adalberti), and others. Using as an example the evolution of the Spanish Imperial Eagle population, we present an overview of the raptor studies in Spain during the last 50 years.

Identifying Power Line Collision Risk Areas for Bald Eagles (Haliaeetus leucocephalus) Using Telemetry Data

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Avian protection is a critical issue for electric power delivery companies. Avian interactions with power lines can result in death/injury for birds and power outages. Pepco Holdings (PHI), a power delivery company, developed an Avian Protection Program (APP) to improve power reliability, ensure customer satisfaction, and minimize risk to birds. PHI utilizes an APP to respond to avian incidents and proactively minimize electrocution and collision hazards on its system. Effective avian protection requires the identification of high priority bird use areas where proactive retrofitting and avian-friendly pole design could prevent electrocution and collision incidents. PHI's service territory includes the Chesapeake Bay and Delaware Estuary where thousands of Bald Eagles congregate year-round from breeding and migratory populations. Bald Eagle collisions with electric infrastructure are increasing in the region and usually result in death or injury to eagles. Mitigation techniques include marking power lines with bird flight diverters to increase line visibility to eagles. PHI collaborated with the New Jersey Division of Fish and Wildlife to identify high priority eagle areas where risk mitigation efforts could be implemented. Telemetry data from a five year tracking study involving seven New Jersey Bald Eagles was used to identify communal roosts and flight paths entering and exiting roosts. Collision risk around each roost was assessed by examining intersections of eagle flight paths with nearby distribution and transmission lines. Using telemetry data, 78 eagle roosts were identified in Maryland, Delaware, and New Jersey. Eagle flight paths highlighted 21 areas around roosts where PHI can evaluate the engineering/construction feasibility of proactive line marking. Areas with the highest collision risk were power lines adjacent to or bisecting water with little to no vegetation to shield the lines. Collision risk and roost locations will be used to inform future eagle management in the region and to prioritize PHI's risk mitigation efforts.

Conservation status and population trend assessment of the Short-rated Owl (Asio flammeus) in North America

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The breeding range of the Short-eared Owl in North America includes all 13 Canadian provinces and territories and approximately half of the 50 U.S. states; the remaining states are part of the wintering range. In Canada, the Short-eared Owl is listed as "a species of special concern" under the federal Species at Risk Act, and as "threatened" or "special concern" in six provinces and territories. In the U.S. it is not listed under the federal Endangered Species Act, but is considered "threatened" or "endangered" in 14 states, and classified by NatureServe as "imperiled" or "critically imperiled" in another 12 states. The outlook for the species is particularly poor in the midwestern and northeastern states. The Breeding Bird Survey is considered the most reliable source of long-term trend data for many species, and shows a significant continental decline for the Short-eared Owl. However, the BBS covers only part of the breeding range of the Short-eared Owl, and is therefore not optimal for monitoring this species. The Christmas Bird Count may provide better coverage for Short-eared Owls, and it too indicates a long-term continental decline, with some regional variation. Several second generation state and provincial breeding bird atlases have also shown a reduction in occurrence of Short-eared Owls compared to initial results approximately 20 yrs earlier. Although the majority of eBird records are relatively recent, comparison with historical data show a considerable decline in frequency of observation of Short-eared Owls, and eBird is likely to become an increasingly valuable tool for monitoring population trends. In addition, recently initiated surveys specifically targeting the Short-eared Owl may become valuable for documenting changes in distribution and abundance.

Raptor Migration Monitoring: What We Have Learned and Next Steps

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Raptors are secretive and wide-ranging and their populations can be difficult to survey and monitor. Since 1934 a growing network of hawk-watch sites have collected data across several continents, with western North America coverage expanding significantly during the 1980s and 1990s, and coverage in Mexico and Central America growing during the 1990s and 2000s. These data have been used to examine population trends since the 1960s, when Rachel Carson used Hawk Mountain Bald Eagle (Haliaeetus leucocephalus) count data in her landmark book, Silent Spring. In 2008, a collaboration of four North American organizations developed the Raptor Population Index Project, and completed the first continent-wide, multi-site analysis and synthesis of the conservation status of North American migratory raptors based primarily on migration count data. Trends are updated biannually by the partnership, and today more than 150 North American sites contribute data to the website database, called HawkCount. Most of the contributions are from volunteer citizen scientists. Count data from this database also has expanded our understanding of the influence of climate change on migration timing, refined our estimates of raptor population size, and improved our knowledge of raptor distribution and movement ecology. The growth in migration watch sites in Europe and other continents offers the opportunity to build a similar large-scale, low-cost raptor-monitoring program that can further enhance raptor science and conservation globally.

Feeding Behavior of Striated Caracaras (Phalcoboenus australis) on insect maggots in kelp wrack on the Falkland Islands

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We studied the behavior of adult and juvenile Striated Caracaras feeding on maggots in kelp wrack on Saunders Island, Falkland Islands in February 2016. Caracaras associate with penguins and other seabirds during austral summer, depending heavily upon their eggs and chicks for food. They also feed in kelp wrack near penguin colonies. We observed flocks of as many as 20 individuals digging with their feet and pulling with their beaks at the wrack to expose kelp-fly larvae. We found that the average ingestion rate was 11.8 per 30-sec foraging bout (n = 85). Ingestion rates were inversely correlated to the amount of digging, but were not associated with visible crop size, age, or sex of the birds. Our calculations indicate that kelp-fly larvae represent an energetically valuable resource for Striated Caracaras providing an average of .09 g (n=286) wet weight per individual larva. Based on an estimated daily food requirement of 10-15% body-mass for similarly sized raptors, at the observed ingestion rate, female caracaras could meet their daily energetic needs in 1.4-2.0 hrs of continual foraging and male caracaras in 1.2-1.8 hrs. We discuss our results in the context of marine food subsidies (i.e., via kelp and its associated invertebrates) as an important food resource for this globally Near Threatened endemic.

Elevated Lead Levels from Ammunition in Swedish Eagles

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Total lead and the lead isotopes 206Pb, 207Pb, and 208Pb were measured in 116 Golden Eagles (Aquila chrysaëtos) (GE) and 199 White-tailed eagles (Haliaeetus albicilla) (WTE) found dead or dying in the wild from 2005-2012. Median / mean values (µg/g d.w.) were 1.4 / 9.2 in GE and 0.86 / 11.8 in WTE. Fifteen percent of GE and 20% of WTE had elevated levels (> 6 µg/g). Seven percent of GE and 14% of WTE had lethal levels (> 20 µg/g). Lead isotope signatures in liver differed from those in air and surface layers in nature, which indicates other sources of lead in eagles. Lead levels were significantly higher in eagles with visible metallic ammunition fragments in the digestive tract ($p < 0.008$). In contrast to other biota no decrease in lead occurred during 1981-2012 in WTE in Sweden. A partial ban of using lead-shot over wetlands enforced in 2002 has showed no effect so far. Median concentrations in WTE in this study are one hundred times higher than those reported for Eagle Owl (EO) (Bubo bubo) in Sweden. The EO utilizes largely the same prey, but is not known to scavenge on offal from game hunting and is thus much less exposed to spent ammunition than eagles. Liver lead concentrations < 0.25 µg/g in WTE shows a significant decrease from 1981-2012 and averaged ~0.1 µg/g by year 2000, as reported elsewhere for EO liver. This indicates that a decrease in background lead concentrations in eagles is masked by ingestion of lead via scavenging on lead-contaminated

offal from game hunting. The low boundary (0.25 µg/g) needed to disclose an expected decline in lead over time in WTE excludes 70 % of the total sample with higher concentrations and implies a strong exposure for spent ammunition on a population level for eagles in Sweden.

History of Contaminant Research with Raptors at Patuxent Wildlife Research Center

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This talk reviews the history of and approaches used in studies focused on the effects of contaminants on raptors and raptor populations by personnel of the Patuxent Wildlife Research Center, Laurel, Maryland. The Center recently celebrated its 75th anniversary, but studies with raptors did not begin in earnest until after 1965. The early 1960s brought the issues of raptor population declines and pesticides together with a compilation of several studies, e.g., Charles Broley's Bald Eagle (Haliaeetus leucocephalus) work in Florida and Maurice Broun's fall migration counts at Hawk Mountain. Bald Eagles were trapped in Alaska in 1961 and 1962 and brought to Patuxent and fed various diets of DDT that killed some eagles; a few unhatched eggs collected all contained DDT residues. Then, came the landmark 1965 Peregrine Falcon (Falco peregrinus) Conference in Madison where it was reported that a resurvey in 1964 of Joseph Hickey's 1939-40 Peregrine survey in the eastern United States yielded no occupied eyries. Derek Ratcliffe noted a sequence of Peregrine population declines in Great Britain that included egg breakage, egg-hatching failure, death of young and failure of adults to lay eggs, which preceded desertion of the territory. Eggs from 14 Peregrines all contained residues of DDT/DDE, dieldrin, and heptachlor epoxide, and Ratcliffe argued that concentrations in some were sufficient to account for sublethal effects leading to reduced breeding success. Round-table discussions on "pesticides as possible factors affecting raptor populations" with Joe Hickey, Ian Prestt, Lucille Stickel, and Bill Stickel were very informative and played a major role in development of the Patuxent approach as the Center increased staff in the late 1960s and early 1970s.

Raptor Mortality in Urban Landscapes

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The habituation of raptors to people, and of people to raptors, coupled with the ever-increasing urbanization of previously wild lands, has led to ongoing expansion of raptor occupancy of urban landscapes. Urban occupancy by raptors creates novel levels, types, and combinations of mortality risk, and subsequently, unique conservation concerns in built environments. Urban raptors can be impacted by collisions with aircraft, automobiles, windows, and wires. Urban raptors also can be impacted by disease, electrocution, entrapment in anthropogenic structures, nest loss during tree trimming, parasites, pesticides, secondary poisoning from rodenticides, and numerous other factors. For both residents and migrants, these factors sometimes collectively outweigh the potential benefits of limited predation and increased prey and nest site availability in urban landscapes, creating ecological traps and sinks. The relative weight and potential demographic effects of various mortality factors differs temporally and geospatially across urban landscapes, and can differ for generalist versus specialist species, directly impacting the relative weight of conservation concerns in different areas. Data on urban mortalities comes from band recoveries, observational studies, radio-tracking, and particularly, from the records of raptor rehabilitation facilities. We will discuss urban mortality factors for diurnal and nocturnal raptors, with a focus on example species. We will also discuss where and how data on urban mortality are collected, and how data sources may create biases in understanding the agents of mortality for raptors occupying urban landscapes.

Rats! What triggers us to control for rodents and how - Rodenticide user survey in British Columbia, Canada

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Anticoagulant rodenticides (ARs), in particular the second generation ARs (SGARs) are used worldwide in agricultural landscapes to suppress rodent populations. However, due to their highly toxic and persistent properties, an increasing number of predators, in particular raptors living on farmland across the globe have been documented with SGAR residues in their systems. Our objective was to evaluate the usage of ARs in Delta, which is the main region where raptor carcasses have been collected for AR residue testing in British Columbia. More specifically, we wanted to assess the role farmers, hobby farmers and residential owners have in the release of ARs into the agricultural landscape. Of the three AR user groups, our survey found that farmers most frequently engaged in rodent control (95%). Hobby farmers and residential owners only engaged in rodent control if rodents had damaged property or had been seen

on the premises. Overall, products containing brodifacoum were most commonly applied (32%), which is also the active ingredient most commonly found in raptor carcasses sampled in the region. Instances of unintended misuse were documented (17%), and these seemed to stem from a general lack of understanding about the differences in toxicity of different AR products. Our survey demonstrates the need for more readily available information for land-owners regarding correct product application techniques and safe disposal of poisoned rodents. In order to reduce the risk of secondary AR poisoning of raptors we recommend that the justification for prophylactic permanent placement of ARs as part of food safety requirements on farms should be carefully re-examined by the regulators and industry.

Evidence for Synchronous Egg Laying and Hatching of the Northern Pygmy Owl (Glaucidium gnoma)

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Photographic documentation and observation of Northern Pygmy Owl nests in Montana suggest that the onset of incubation, egg hatching, and chick fledging occurs synchronously or nearly so. Although synchronous hatching has been previously suspected for Pygmy Owls, little evidence has yet to be reported. For all other owl species where information is known, incubation begins with the onset of egg laying and thus egg hatching and development occur asynchronously. Because owls are altricial at birth, adaptation towards asynchronous hatching and chick development appear to potentially reduce negative effects of predation and reliance on fluctuating prey populations. The synchronous hatching and development of Northern Pygmy Owls suggest that their young are perhaps less vulnerable to predation (i.e. small nest cavities) and unpredictability in prey species abundance (i.e. diverse prey base).

Declining Populations of Long-eared Owls (Asio otus) in Western Montana: Results of Long-term Research

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Long-term research and monitoring are the only way to detect trends in animal populations and related demographics. After 30 yrs of year-round research on Long-eared Owls in western Montana, we have seen a clear downward trend. Reasons for this remain speculative, as a variety of factors are implicated. Habitat change and loss are likely influences. The Long-eared Owl's downward trend is consistent with other open country species of owls, such as Snowy Owls (Bubo scandiacus) and Short-eared Owls (Asio flammeus), and other species of temperate zone birds. In 2013, populations of Long-eared Owls in Canada and the United States were estimated at 15,000 (9,000 in Canada and 6,000 in United States). If true, the Long-eared Owl population estimate is similar to those of Flammulated Owls (Psiloscops flammeolus) and Spotted Owls (Strix occidentalis), both of which have federal, state, and regional status concerns. Furthermore, the Long-eared Owl population estimate is the lowest for any owl species that breeds regularly in the United States. By conducting long-term research and monitoring on local and large geographic scales, a more accurate view of populations is likely to emerge. This should lead to more realistic and meaningful conservation and management decisions.

Declining Populations of Snowy Owls (Bubo scandiacus) in Barrow, Alaska: Results of Long-term Research

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Long-term research and monitoring is the only way to detect trends in animal populations and related demographics. Unfortunately most wildlife studies last one to three seasons and do not provide adequate data to address trends. However, by conducting long-term research and monitoring at local and large geographic scale, a more accurate view of populations is likely to emerge. This should lead to more realistic and meaningful conservation and management decisions. After 25 years of breeding research on Snowy Owls and Brown Lemmings (Lemmus trimucronatus) in Barrow, Alaska, a downward trend is evident for the Snowy Owl. Reasons for this decline are unclear and are speculative. Habitat loss does not appear to be a problem, although some loss has occurred. However, effects of climate change on lemming population fluctuations in the Arctic ecosystem could be important. In one report, population estimates for the Snowy Owl are about 100,000 in Canada and the United States. In a separate population genetics study, the world estimate for female Snowy Owls is about 14,000. It remains uncertain if any population estimates for Snowy Owls are realistic.

High Heterozygosity and Limited Structure in the Fragmented Northern Goshawk (Accipiter gentilis) Population of the Eastern U.S.

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Anthropogenic activities can have drastic effects on wildlife populations. Habitat destruction, fragmentation, degradation, and pollution can lead to population declines that can cause genetic bottlenecks and significant losses of biodiversity. Populations of the Northern Goshawk in the northeastern United States are small and have recovered from declines driven by substantial human prosecution and habitat change in the past 150 years. In addition, the species has limited nesting habitat in the east due to the severe fragmentation of mature forest and it is identified as a species of conservation need in several eastern states. We used a suite of nine microsatellite markers to evaluate patterns of genetic diversity and population structure in Northern Goshawks from eastern North America. Preliminary analyses of 48 individuals suggested higher than expected heterozygosity (He = 0.70) and very limited population structure (FST = 0.012). In addition, we found no evidence of inbreeding (FIS = 0.005) or genetic bottlenecks in the population (under the two phase mutation model: Sign test p = 0.589; one tailed Wilcoxon test for H excess p = 0.47). These results suggest Northern Goshawks in eastern North America have not suffered genetic consequences of small populations, habitat fragmentation, or bottlenecks. As such, although their populations remain small, they appear not to be burdened by many of the typical genetic constraints facing other conservation-reliant species.

Trends in Body Condition of Autumn-Migrating Raptors Along the Kittatinny Ridge, Pennsylvania, 1978 – 2014.

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The Kittatinny Ridge is a key North American migration corridor for autumn-migrating raptors traveling from northeast to southern states and into Central and South America for the non-breeding season. In this study we assess size and body condition of migrating raptors using the corridor and evaluate trends in body condition from 1978 to 2014 for the more common species. Condition was evaluated by dividing body mass by wing chord for each migrant (n= 12,840). Where mass varied among sex and age classes (i.e., accipiters and falcons), the condition index was calculated separately for each sex-age group. For buteos, the index was calculated by age class only. Body condition index increased during the study time period for male after-hatch year and female hatch-year, and after-hatch year Cooper's Hawks (Accipiter cooperii). Hatch-year Red-tailed Hawks (Buteo jamaicensis) and male after-hatch year Sharp-shinned Hawks (Accipiter striatus) also showed increased body condition index. None of the other species-age groups showed a significant change in body condition across years, although some non-significant increases were detected. Our analysis suggests migrating raptors using the Kittatinny Ridge have healthy or increasing body condition, and that the body condition index may be a useful method of tracking migrant raptor health in migration corridors. Results will be discussed in relation to changes in species distribution and conservation status in northeastern North America.

Annual Movements of the Short-eared Owl (Asio flammeus) in Western North America Revealed by Satellite Telemetry

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We attached satellite transmitters to 26 Short-eared Owls in western and interior Alaska in June 2009 and July 2010, respectively, and tracked owl movements for up to 19 months post-deployment. Most owls left Alaska following the Tanana River Valley into the central Yukon Territory, and then east of the Rocky Mountains and into the Great Plains provinces (Canada) and states (U.S.A.). A small number of Short-eared Owls followed a more coastal route west of the Rocky Mountains, including one owl that crossed the Gulf of Alaska. Total tracking distances for completed autumn migration ranged from 3,205–6,886 km. Owls wintered across a substantial portion of western North America, spanning 21° of latitude from central Montana to southern Texas, and 24° of longitude from central California to western Kansas. Throughout the Short-eared Owls' annual cycle, birds displayed a variety of both sedentary and nomadic movements in both agricultural and native open-land habitats. We documented only one instance in which an owl returned to a previously visited area, and no tracked owls returned to Alaska. Although most Short-eared Owls

generally moved north in the spring and south in the fall, those movements were highly variable with little site fidelity, and as such we consider the owls to be largely irruptive and facultative migrants in Western North America.

Advances in Tracking Movement of Raptors

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Tracking movement is an important theme in raptor research. Over the past 50 yrs, the techniques used to track movement of raptors have improved dramatically. To understand the development of tracking studies over time and to describe the techniques used, I surveyed all issues of The Journal of Raptor Research (JRR) from its inception (as Raptor Research News) in 1967 through 2016. The simplest and oldest way to track movement of raptors is via banding, and such studies have been a part of JRR since two were first published in 1970. Although banding is basic, analysis techniques and band records have improved and more than half of banding studies in JRR have been published since 2009. The most commonly used mechanism to track movement of raptors is via conventional VHF radio tracking. VHF is useful because it can be used with small raptors and ≥ 82 such studies have been published in JRR, generally 0-6 per year, the vast majority from 1980 to the present. Since 2002, there have been ~30 satellite telemetry studies, nearly all using the ARGOS satellite system and either Doppler shift or GPS to determine animal location. Since 2010, several new techniques have arrived on the animal tracking scene. These include GPS systems that allow download via either the mobile phone network (three studies) or a VHF connection (one study), light-level geolocators (one study) and stable isotope ratios (three studies). Although banding, VHF and satellite technologies provide less information than does use of more recently developed technologies, they have a number of strengths and they should remain prominent in the literature as other techniques continue to be developed and refined.

Engineering Protection for Peregrine Falcons (Falco peregrinus) on Major Bridge Rehabilitation Projects in the Delaware Valley

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With increasing presence of raptors in urban environments, conflicts between birds and construction are also increasing. Peregrine Falcons on bridges are a prime example of this conflict. In a falcon's eye, a bridge is prime habitat: there is space for a protected nest, high areas for perches, and lots of prey. Once chosen, succeeding generations of falcons may occupy the bridge indefinitely. Bridges, however, do not have the permanence of a stone cliff; they deteriorate. At some point they have to be repainted and/or repaired for public safety. In the engineer's eye, the pair of falcons are a bureaucratic and environmental nightmare that delays construction until the bridge falls down. For the contractor preparing a bid, it can seem like an impossible and worthless task to protect two little birds. For someone protecting the falcons, they might say: "You are never touching the Falcon's bridge"! Along the Delaware River Valley, however, bridge owners, engineers, contractors, and conservationists have worked together to resolve this conflict for over twenty years. This talk, presented by a bridge engineer, is a review of how designers "engineer protection" into the plans and how the construction is managed to protect Peregrine Falcons during major rehabilitation projects on bridges in Pennsylvania and New Jersey. It explains things each stakeholder should know about the process for successful protection of Peregrine Falcons during bridge rehabilitation projects. The success of the program jointly conducted by the Pennsylvania Game Commission and the New Jersey Department of Environmental Protection for the Delaware River Bridges is presented as an example for other agencies to follow. Keys to resolving the conflicts include open communications by all stakeholders, education and understanding of falcon behavior, education and understanding of the design and construction process, willingness to rework plans, and seeking out win–win solutions.

Kin Associations in Migrating Northern Saw-whet Owls (Aegolius acadicus)

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Migration is a critical behavior in the life history of migratory birds. Migratory birds that maintain post-fledging kin associations often do so to structure the formation of their flocks. Terns, cranes, geese, swans, and other waterfowl are known to migrate together in family groups of parents and young. Little is known about the kin associations of migratory owls. In this study, we used a genetic analysis to answer the question: do Northern Saw-whet Owls (NSWO) maintain kin associations during fall annual migration? We selected potential hatch-year sibling pairings or female-hatch-year pairings of fall migrating NSWOs from Pennsylvania, Montana, and California during 2004-2006. Potential pairs were netted on the same night. A

700 nucleotide base pair fragment of the tRNA-Glu/control region of the mitochondrial DNA was used to detect closely related individuals. As a whole, NSWO exhibited a high degree of genetic variation. No potential hatch-year siblings or female-hatch-year pairs had the same genetic sequence. Only one potential hatch-year sibling pair was revealed, based on sharing an identical genetic sequence, but the two owls were caught in different states during the same migration year. Based on our sampling, it does not appear that hatch-year NSWOs maintain kinship after fledging, suggesting migratory behavior is instinctual rather than learned.

Urbanisation of the Northern Goshawk (Accipiter gentilis) in Germany

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The Northern Goshawk as a forest dwelling raptor has a secret life and is normally rarely noticed. However, the urbanisation of Northern Goshawks has been recorded more than 10 yrs ago in Germany. Large forests in the margin of the cities were the first stepping stones for this species to enter parks and graveyards which can be found even in the center of towns, where they nowadays are seen frequently. Lack of persecution and plenty of food, combined with suitable old trees for breeding are essentials for establishing growing urban populations. This phenotypic plasticity allows the Northern Goshawk to adapt to the omnipresence of humans in this new environment. To test this hypothesis, we measured different behavioral and ecological traits between urban and rural populations. Diversity of prey items, reproductive success, and defending behavior, but also the parasitic infection risk, mortality rate, and causes of death are considered. Preliminary results from 2014 and 2015 show striking differences between urban and rural goshawk populations. In urban areas we found significantly higher breeding success, lower diversity of prey items, higher rates of parasite infections in nestlings, and contrary defending behavior of adult birds at the time of banding the chicks in the nest. In contrast to rural nesting sites where adult goshawks disappear, at urban nests the parents actively defend their offspring, by even attacking the bird ringer. These first results strengthen the conclusion that the phantom of the forest seems to be able to be a successful urban citizen.

Gray Hawk Expansion in the San Pedro River Valley: Habitat, Diet, and Density Dependence

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Models of ideal despotic distribution predict that populations of territorial animals will exhibit density dependent growth because newly arriving individuals will be relegated to inferior habitat where productivity is lower. Interference can also be a mechanism for density dependence if individuals devote more energy to territory defense (and less to reproduction) as an area becomes more crowded. I examined these hypotheses in an expanding population of Gray Hawks (Buteo plagiatus) in southeast Arizona. As Gray Hawk numbers increased, pairs began to settle at higher elevations and in places with different foraging habitat. In the most recently occupied environments, pairs likely foraged in grasslands or oak woodland as opposed to mesquite bosques. I assessed vegetation and productivity in new and historical territories to determine if fecundity is declining with population growth and whether habitat heterogeneity might contribute to this pattern. I also analyzed nestling diet to assess how foraging habitat might affect the quantity and composition of prey that Gray Hawks feed their chicks. Preliminary results suggest that nest success is lower in the most recently occupied environments, though paradoxically, fecundity may be higher for individual nests that do succeed. Mammals appear to comprise a greater portion of Gray Hawk diet in areas with grassland foraging habitat. Diet in oak woodlands seems the most diverse because it is the only one to include invertebrates.

Quantifying Animal Behavior Using High Frequency GPS Sampling and Accelerometry Data

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Understanding animal behavior, how an animal spends its time, when and where an animal moves, how an animal moves, and when an animal feeds are all critical to understanding energy budgets. To improve our understanding of energy budgets, we continuously tracked 10 Bald Eagles (Halieeatus leucocephalus) in eastern North America using CTT third-gen GSM/GPS telemetry (Cellular Tracking Technologies). We recorded GPS data at 5 sec intervals and we recorded triaxial accelerometer data at 40Hz (forty points per second) during flight. We collected between 600,000 to just over 1,000,000 accelerometer data points per bird per day. We used the GPS data to determine flight speed, altitude, and location. We used the high-resolution accelerometer data to determine wing-beat

frequency and the amount of time eagles spent flapping. We converted this information to energy consumption during flight. These data provide, for the first time, an accurate estimate about the amount of energy Bald Eagles use during flight.

Breeding Ecology of the Northern Hawk Owl (Surnia ulula) in Montana

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Thirty-six breeding records of Northern Hawk Owls from Montana, U.S.A. are reported, 17 of which contain a known nest-site location. One nest was used in subsequent years, although the identity of females was not known. All records occurred in moderate to severely burned forest of 1-11 yrs of age (post-burn). Known nests were found in Black Cottonwood (Populus trichocarpa) (n=8), Aspen (Populus tremuloides) (n=6), Engelmann's Spruce (Picea engalmannii) (n=2), and Larch (Larix occidentalis) (n=1). Average nest tree height was 19.57 ± 3.36m (95% CI, n=17), average nest height was 14.07 ± 1.61 m (95% CI, n=17), and average diameter-at-breast height was 43.29 ± 4.09cm (95% CI, n=17). Average measurements of nest tree height and nest height were significantly larger than from those reported elsewhere in North America. Diet based on 230 prey retrieved from pellets was 89% voles, most frequently Microtus pennsylvanicus (53%, n=230). Only 1 of 72 marked individual owls was recaptured or recovered over the course of a 10-year study, suggesting a non-sedentary population with low site fidelity. Although still considered a rare breeder in the continental United States, breeding records exist for 11 of the last 12 years in Montana. All but five breeding records in the state have occurred within the boundary of Glacier National Park.

Winter Roost Sites of Northern Saw-whet Owls (Aegolius acadicus) in Missoula, Montana

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From 2012-2016 we documented 39 individual winter roost locations for Northern Saw-whet Owls in deciduous woody draws adjacent to open, native bunchgrass habitat in Missoula, Montana, U.S.A. Roost locations were predominantly located in Hawthorne (Crataegus spp.) shrubs (79%, n=39) with an average roost height of 176cm ± 39 (95% CI, n=39). Average branch diameter of roost was 22mm ± 4 (95% CI, n=39). We estimated horizontal and overhead cover within 1 m of roost with a densitometer. Vertical cover was 69% ± 5 (95% CI, n=32) at roost. Horizontal cover was lowest in the direction in which the owl was found facing (55% ± 8; 95% CI, n=31) and was outside the 95% confidence interval for pooled average percent cover of three other directions about roosting owl (75% ± 3; 95% CI, n=32). Dietary analysis of pellets found at roosts showed that Microtus vole species are the primary prey of wintering Northern Saw-whet Owls. Although relatively small in area and often overlooked, deciduous woody draws near open-country habitats may provide important cover for wintering Northern Saw-whet Owls.

Routes, Timing, and Wintering Areas of Migratory Flammulated Owls (Psiloscops flammeolus)

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Determining patterns in annual movements of animals is an important component of studies in population ecology, particularly for migratory birds, where migration timing and routes, and wintering habitats have key bearing on population dynamics. We used light-level geolocators to provide the first documentation of migratory movements in Flammulated Owls from 2009-2016. Four males departed Colorado breeding areas for autumn migration from 5-21 October, and arrived on wintering areas in Mexico between 11 October and 3 November. They departed wintering areas from 6-21 April, and returned to Colorado between the 15th and 21st of May. Kernel density estimates indicated core wintering areas for three males in central Mexico, where they were primarily associated with the Trans-Mexican Volcanic Belt in Jalisco, Michoacán, and Puebla, while the core area for one male was associated with the northern Sierra Madre Oriental Mountains in Tamaulipas. Mean distance from breeding areas to wintering areas was 2057 + 128km. Fall migrations were characterized by two flight pathways, as two males took a path to eastern Mexico and two males took a path to central Mexico. Spring migrations were characterized by a singular pathway, as all males traveled north from Mexico along the Sierra Madre Oriental Mountains to the Rio Grande River, and north through central New Mexico. The most prolonged stopovers by all males during both migrations occurred in New Mexico, just 300km from breeding areas. In the spring, this final stopover may have functioned in adjusting timing of return to high elevation breeding areas, where late snowstorms are not uncommon. One male, tracked over two years, showed similar patterns in migration routes, timing, and wintering

areas between years. Vegetation within core wintering areas and at many stopovers was associated with evergreen forest/woodland, suggesting conifer forests are important habitats throughout the owl's annual cycle.

Home Range, Territorial Behavior and Individual Interactions of Breeding Bonelli's Eagles (Aquila fasciata) Tracked by High-resolution GSM/GPS Telemetry in Spain

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We are living in a technology-driven era of biological discovery. In the field of ornithology, tracking technologies have facilitated dramatic advances in the understanding of ecology and animal behavior. In this presentation we will show the preliminary results of an on-going remote tracking project of breeding Bonelli's Eagles in Eastern Spain. The Bonelli's Eagle is a long-lived endangered species in Europe which main threats include high mortality due to electrocution, collision with power lines, and direct persecution (i.e., mainly poisoning and shooting). Thanks to high-resolution GSM/GPS telemetry we have obtained more than 1.5 million GPS locations of six neighboring breeding pairs (including 13 different individuals). Home range areas reported here were larger than those previously reported using conventional radio-tracking. Home range size was smaller during the breeding season (January – June) than during the non-breeding season (July – December). Eagles are resident throughout the year, showing strong territorial behavior and site fidelity. Nonetheless, short-time sporadic interactions were recorded between neighboring pairs during the annual cycle. Males and females spent most of their time together, which is due to cooperative hunting behavior. Interestingly, eagles made long-distance (> 40 km) occasional movements (which we called "excursions") both during the breeding and non-breeding season. During these excursions, usually taking less than 1-2 hrs, birds flew over other neighboring territories probably to explore new potential mates. Space use varied considerably within the home range and remarkably, places located far from nesting sites were used more frequently than some areas located closer. Therefore, traditional conservation measures based on establishing restrictive rules within a fixed radius around nesting sites could be biologically meaningless if other areas within the home range are not protected too. High-resolution telemetry is facilitating improved insight into raptors' spatial ecology and behavior, which is key for the conservation of endangered species.

Pre- and Post-Construction Power Line Collision Risk Assessment for Raptors at Kittatinny Ridge

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The Susquehanna-Roseland (S-R) project is a 500-kilovolt (kV) 55-60m tall transmission line which included the rebuilding of a 230kV, 20-25m tall single-circuit in 2013. The S-R line follows an existing transmission right-of-way spanning Kittatinny Ridge, part of the Appalachian Raptor Migration Flyway in Pennsylvania and New Jersey. The 500 kV transmission line was constructed with bundled conductors with spacers that helped increase line visibility. The overhead static wires were marked with bird/swan flight diverters at the Kittatinny Ridge crossing. Prior to construction in 2013, fall migration data were collected on Kittatinny Ridge establishing baseline raptor movements to assess potential collision risks with the taller S-R line. The survey protocol adhered to Hawk Migration Association of North America's (HMANA) standard data collection protocol for raptor migration monitoring. Additionally, each observer used laser range finders to record distance and angle of each crossing raptor. Two years of post-construction data were collected using the same techniques. All observations were merged with engineering's PLS-CADD line design model, depicting the transmission structures and wires in three dimensions. This novel approach allowed three-dimensional raptor locations and the line to be viewed together at any angle, and for efficient comparisons of pre and post-construction raptor crossings. Pre-construction, 3,698 raptors were detected, with 71.6% of crossings above the proposed height of the S-R line, while 24.0% passed through the theoretical wire zone. In contrast, post-construction, a total of 7,875 raptors crossed the S-R line during 2014 and 2015 with 89.6% (n=70,565) crossing above the new wires. This resulted in significantly fewer raptors passing through the wire zone (6%). Birds passing through the wire zone (n=322, 66%) were comprised mostly of vultures. Additionally, the observers had a clear view of the new S-R transmission wires for 1,780 hours, and no avian wire collisions were noted.

Landscape Composition and Year Effects on Northern Saw-whet Owl (Aegolius acadicus) Nest-box Occupation Over one Decade in Northwestern Quebec

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Loss and fragmentation of forest habitats have negative repercussions for organisms associated with them, reducing their productivity directly or indirectly by affecting their physiological condition or that of their young. The Northern Saw-whet Owl is one species potentially impacted by loss of mature forest habitat. From 2005 to 2015, we used a network of 312 nest boxes to document the reproductive success of >60 pairs in mixed boreal forest in the Abitibi region of Quebec. We measured forest composition and habitat fragmentation at the home range scale. Compared to other factors affecting the reproductive success of birds of prey, such as precipitation, adult age, and year effects, forest composition and configuration variables had little influence on nest box occupancy. Precipitation during the breeding period had a negative effect on clutch size and fledging success. Fledging success was also reduced by 20% when the male was in its first breeding attempt. Among raptors, few studies have considered the effects of loss and fragmentation of habitat simultaneously with other factors which may reduce the occupancy or reproductive success of adults. In a predominantly forested context (> 30%), our conclusions suggest that Northern Saw-whet Owls are relatively resilient to habitat loss and fragmentation.

Population Dynamics of Urban-Nesting Raptors

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Many species of hawks and owls nest in urban environments where they sometimes are relatively free of predators and competitors, and frequently have access to abundant and stable sources of food, nest sites, and other important resources. Living in urban environments, however, potentially exposes them to "environmental challenges" or novel agents of mortality such as electrocution, poisoning, exotic diseases, human disturbance, and collisions with windows, cars, and power lines. The interplay between access to abundant resources and exposure to environmental challenges results in population dynamics that are complex and often species- and location-specific. Populations of some species can occupy a range of urban environments and grow rapidly in urban settings, but may do so in unconventional ways. For example, a population of Cooper's Hawks (Accipiter cooperii) in Tucson, Arizona, continued to expand, despite a 40% mortality of nestlings due to trichomoniasis, primarily because survival of hawks in their first year of life (if they survived the disease) was exceptionally high. Other species, such as Burrowing Owls (Athene cunicularia), often increase in nest density and rates of survival and productivity with increasing levels of urbanization up to a threshold, and then survival and productivity decline rapidly. Responses to urban environments also appear to be location-specific. Western Screech-Owls (Megascops kennicottii) are common breeding residents in towns and cities in the deserts of the southwestern United States, but are largely absent from urban areas in the deserts of Baja California. Finally, some species, such as Red-tailed Hawks (Buteo jamaicensis) and Peregrine Falcons (Falco peregrinus), can nest successfully in urban environments but are not more productive than when nesting in non-urban settings.

What Is Happening with American Kestrels (Falco sparverius) at the Dump in Massachusetts?

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The American Kestrel has experienced widespread population declines, and this may be most pronounced in the Northeast. However, in suitable habitat, Kestrels can be one of the more commonly observed species of raptors during migration. The Carver/Marion/Wareham (CMW) landfill is partially capped and provides 21.85ha of grassland habitat in southeastern Massachusetts. This regionally large grassland may attract American Kestrels and other open-space foraging raptors during migration. Since 2012 raptor trapping has been conducted at the CMW landfill during both spring and fall migration. In total, 209 individuals of seven species of raptors have been trapped with the great majority (83%) of these being American Kestrels. Captures of American Kestrels are most pronounced during the first 2 wks in April and the first 2 wks in August. During trapping sessions, American Kestrels are commonly observed hunting over the landfill slopes. Some of the captured American Kestrels represent local nesters, as 16% of total captures are recoveries of banded birds from a local nest box study. Additionally, foreign recoveries were documented from Connecticut, New Jersey, Pennsylvania, and New Hampshire. Although foraging opportunities in grassland habitat at capped landfills may attract migrating raptors, sites with methane burners present a potential hazard for birds. There is a small 'candle stick' methane burner at the CMW landfill that was retrofitted with an anti-perch 'crown' in 2010. Since the installation of the crown, a single methane

casualty, an American Kestrel, was reported. However, that bird retained its flight capabilities.

Nest-Site Selection by Broad-winged Hawks (Buteo platypterus) in Pennsylvania

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Broad-winged Hawks are secretive forest nesting raptors that are rarely seen during nesting. Breeding Bird Atlas surveys in Pennsylvania suggest numbers of nesting pairs has declined in some regions. Most habitat studies of this species were conducted more than 30 yrs ago when eastern landscapes were very different, and the need for evaluating nest distribution and landscape attributes is necessary for effective management. In 2013-2015 we located 24 active Broad-winged Hawk nest sites in four regions of Pennsylvania, and examined nest success and nest-site preference. We compared land cover in a 1 km radius of known nest sites to land cover surrounding all available forest sites within a 10 km distance of each nest site. Six landscape cover types were compared for the 24 nest sites and their available forest sites within four regions. Overall land cover values did not differ from nest sites compared to available forest sites within regions, but there were significant differences for four of the six land cover classes among regions (1.Wetlands/Water, 2. Developed, 3. Shrub Cover, and 4. Mixed/Evergreen). Broad-winged Hawk nest-site selection was evaluated using land cover, forest patch size, and other landscape attributes, and landscape attributes of successful and unsuccessful pairs was also compared.

The Power and Peril of Nest Boxes for Managing and Monitoring American Kestrels

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Despite their common use, the efficacy of nest boxes as tools for managing and monitoring birds depends on the demography of the target population and the availability of natural cavities. Yet, no one has articulated the demographic or environmental conditions enabling nest boxes to be useful or harmful, because simultaneous monitoring of nest boxes and natural cavities is rare. We use a simulation model for a hypothetical population of American Kestrels (Falco sparverius) to show that providing nest boxes will only benefit populations if breeding sites are limiting or if nest boxes increase productivity or survival relative to other nest sites. We also demonstrate negative effects on populations if birds using nest boxes experience lower reproductive success or survival. Further, trends in the occupancy of monitored nest boxes will be misleading if the number of unmonitored nest sites changes over time. Finally, breeding site fidelity can cause an initial lag in occupancy of newly installed sites that could be misinterpreted as an increasing population, even when the population is declining. There are therefore many situations where the installation of artificial breeding sites, and their use in monitoring, can be misinterpreted or have negative consequences.

An Empirical Observation of Wintering Snowy Owls (Bubo scandiacus) Adjusting to Changes in Coastal Habitat in New York State

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This study presents 26 yrs of empirical observation of how wintering Snowy Owls have been impacted to some degree with respect to how they utilize coastal habitats that have undergone changes in land use/development and farming practices, in addition to human and wildlife encroachment. We explore how habitat fragmentation and commercial development of a 3.2 km stretch of Lake Erie shoreline near Buffalo, New York has impacted where Snowy Owls roost. Secondly, long term observations demonstrate how duck hunting and changes in shoreline habitat in Oswego Harbor have reduced the duration of time that Snowy Owls use this area. Lastly, Cape Vincent, New York has historically been a safe haven for wintering Snowy Owls but changes in land use and elevated levels of human and wildlife encroachment have negatively impacted where Snowy Owls roost and hunt in this region. These observations suggest that although Snowy Owls will always be attracted to these coastal environments, they're utilization of this resource has been slowly altered and subtly stressed and may pose some unwanted obstacles to the survival of wintering Snowy Owls.

Lead Poisoning in Raptors: An Introduction to the Physiological Effects, Diagnostic Options, and Treatment of Lead in Individual Animals

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Lead poisoning is one of the leading causes of intoxication in raptors admitted to wildlife rehabilitation facilities in North America. In most cases, lead is ingested, solubilized in the acidic environment of the stomach, absorbed through the small intestine, and bound to red blood cells where it is distributed throughout the body. Lead is compartmentalized in three main tissue types that differ in their rate of exchange. Four percent of the total body burden of lead exists in the blood and vascular organs where it is quickly exchanged with other tissues. Two percent exists in the soft tissue (muscle, nerves, etc) and has an intermediate exchange. Ninety-four percent is stored in the bone and has a slow rate of exchange. Clinical signs of lead poisoning may be acute, chronic, or subclinical and vary in presentation and severity depending on the lead concentration, location within the body, and individual characteristics, such as life stage and species. Typically the gastrointestinal, nervous, respiratory, cardiovascular and renal organ systems are most affected. Typically a blood sample is needed to diagnose lead poisoning in living raptors, however this method has its limits. While current blood diagnostics assess the presence or absence of lead, the value of blood lead concentration, treatment progress, and radioisotope analysis, for quantifying total body lead burden is limited at this time.

Owl Occurrence in the Toluca Volcano, State of Mexico, Mexico.

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Although, there is a great deal of literature regarding owl populations in the United States and Canada, there is insufficient or no information regarding southern populations of widely distributed species in North America. In many areas of Mexico, the presence of the species is just a "potential" distribution with unconfirmed presence. As the success of biological conservation strategies depends on previous biodiversity knowledge on the areas where they are implemented, the need of further research in Mexico on owl populations and their communities to assess population status and manage these species and their habitat is vital. We present the first study of owl occurrence with field methods in the Toluca Volcano National Park, State of Mexico.

Diurnal Raptor Take-Off Kinematics: A Comparative Study

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Using high-speed 3D video and a synchronized custom data acquisition station, we measured the kinematics and force profiles of several species of diurnal raptors during takeoff. Migrating Cooper's Hawks (Accipiter cooperii) and Sharp-Shinned Hawks (Accipiter striatus) were filmed after being banded by the Cape May Raptor Banding Project, allowing us to study birds under natural conditions in the field. Four Harris Hawks (Parabuteo unicinctus) flown for falconry also were studied taking off from a perch and flying toward the falconer in the field. We describe our custom integrated field 3D video recording station that uses Streampix software to capture synchronized video from three 90 frame/s cameras in tandem with synchronized audio, force, and wind velocity data from additional sensors. Custom Matlab image processing code was used to track features on the birds in flight, and then DLTdv5 was used to compute 3D flightpaths. These reconstructions were used to determine velocity and acceleration profiles, along with the motion of various parts of the bird's body (wings, tail, head and legs). We present results for the take-off acceleration, time scale, final speeds, wingbeat frequency and coordinated tail-and-wing motions for these birds.

Cooperative Snowy Owl (Bubo scandiacus) Winter Mortality Investigation, 2013-2016

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This report presents the findings from a portion of the work done by veterinary team members from Project SNOWstorm, during the Snowy Owl irruption in the winter of 2013-2014 and continued through the following two winters. The veterinary team conducted gross necropsies and collected morphometrics on 153 birds found in nine states, the District of Columbia, and three Canadian provinces during these three seasons. Sixty birds were female, 82 were male, and 11 were undetermined. Identical diagnostics were not run on all specimens, but diagnostics conducted on at least 35% of the birds included radiographs, liver toxicology screens for heavy metals and second generation anti-coagulant rodenticides, histopathology, parasite collection and identification, and general screening for pathogens. During the first winter, the majority of mortalities were associated with trauma (largely vehicular impact), and most of these birds were in good body condition. During the subsequent two winters, the majority of the birds were in a thin to emaciated body condition, and many had secondary fungal, bacterial or parasitic infections. Data analysis shows that while many birds did have exposure to rodenticides, heavy metals and organochlorines, levels were not high enough to be a significant contributor to mortality. Nearly all birds, regardless of body condition, were infested with external lice of the genus Strigiphilus.

Annual Variation in Breeding Densities of Short-eared Owls (Asio flammeus) in the Northern Great Plains and the Intermountain West of North America.

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The Short-eared Owl is an open-country, ground-nesting species found in marshes, grasslands, shrub lands, 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. Using eight years of multi-species avian survey data from the northern Great Plains and two years of intensive Short-eared Owl survey data from Idaho, we demonstrate the dynamic nature of this species' abundance and distribution. Our work provides important data that may help in the planning and interpretation of future monitoring efforts to ensure that project objectives can be met.

Juvenile dispersal of Bald Eagles (Halieeatus leucocephalus) in the Chesapeake Bay, Virginia, U.S.A

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Long-lived species of raptors tend to mature slowly and have a prolonged but poorly understood pre-breeding phase. To better understand this phase of the life-cycle of Bald Eagles (Halieeatus leucocephalus), we tracked 17 nestling Bald Eagles from 13 nests during 2013 – 2015 in the Chesapeake Bay region of Virginia, U.S.A. Between 2013 and 2016, we tracked these eagles for an average of 618 ± 386 ds (±SD; range: 79 – 1054) and collected a total of 1,731,333 GPS locations (mean: 101,753/bird ± 84,729; range: 8,266 – 241,509). Our analysis suggested that eagle movements were highly variable among individuals. Eagles fledged between 16 May–13 Jun (1 Jun ± 6.1 days) and dispersed from their nest site 57 ± 15.5 ds later (range: 44 – 97 ds) from 14 Jul – 31 Aug. Maximum dispersal distance was 1040 km and the minimum distance was 9 km. On average juveniles dispersed 360 ± 74.7 km. Direction of long-distance movements varied, but typically they were to the north (n = 12; 70.5%) and rarely to the south (n = 3; 17.6%) or east (n = 1; 5.8%). These long-distance movements were typically short-lived (i.e., eagles returned to their general natal area) and usually occurred within a month of leaving the nest site. However, juvenile eagles occasionally moved far from the natal area in subsequent years and stayed at a distant site for as long as 3 mos, a movement that might be described as migration. Following dispersal from the natal area, juvenile eagles utilized a variety of habitat types including densely populated urban areas (e.g., New York City, NY), upland agricultural areas, landfills, airports, and wildlife refuges. Our data highlight the highly variable nature of juvenile Bald Eagle movements and

allow us to understand potential threats eagles may face following dispersal from their natal areas.

Flight Behavior of Migrating Snowy Owls (Bubo scandiacus) in North America

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Snowy Owls are an irruptive species and very little is known about their flight behavior during migration, and what with threats and obstacles they face during flight. To better understand these we captured 43 Snowy Owls during winter (2013 – 2016) in central and eastern North America and tracked them using GPS/GSM telemetry. We collected a total of 30,729 GPS locations during migration from 25 owls and recorded 1,305 in-flight locations. Owls generally departed wintering grounds from Mar – Apr, but occasionally later. Owls migrated during every hour of the day, but migratory flight occurred most often from 5 pm – 5 am. During migratory flight, Snowy Owls flew relatively low (278.9 ± 168.4 m above sea level (ASL) and 60.2 ± 51.2 m above ground level (AGL)). The maximum flight altitude was 1498.7 m ASL and 1221.3 m AGL, but flight altitudes above 800 m ASL were rarely recorded (1.1 %; n = 14/1,305 locations) and occurred during daytime. Owls crossed a variety of land cover types during migratory flight. However, while the Snowy Owls that we tracked regularly used urban areas during winter, they rarely flew over urban areas during migration (n = 4 owls and 9 GPS points). Owls regularly crossed large water bodies during both migratory and non-migratory flights. They flew lowest over water (25.0 ± 26.1 m AGL), barren areas (30.0 ± 14.4 m AGL), and grasslands/crops (41.8 ± 26.7 m AGL) and highest over closed forest (108.5 ± 72.0 m AGL). Data show that Snowy Owls migrate at low altitudes mostly at night, when weather conditions (inversions, low solar radiation, low wind speeds) during night likely prevent Snowy Owls from flying at higher altitudes. Our data also suggest that owls may face the greatest risk from obstacles located on or near water and in open areas.

Insights into Cooper's Hawk (Accipiter cooperii) Ecology from Studies in Urban Environments

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Cooper's Hawks were among the species of North American Accipitriformes that declined substantially during the mid-1900s, likely due to pesticide-induced reductions in reproductive success and possibly decreased survival. Subsequent to the 1972 ban in United States on the sale and use of DDT, Cooper's Hawk populations increased substantially. Not only have Cooper's Hawks seemingly re-established breeding numbers in historical habitats in eastern North America, but across the continent breeding Cooper's Hawks have expanded into suburban and urban settings. Urban and suburban development has also encroached into formerly natural Cooper's Hawk habitat. The expansion into and encroachment of suburban and urban habitat has afforded a unique opportunity to observe the colonization process of this species, and to study the ecology of this raptor in an environment where avian prey are exceptionally abundant, and potential disturbance is frequent. In this paper we review the insights into Cooper's Hawk ecology obtained through recent studies of its ecology in suburban and urban settings across North America.

Golden Eagles: A Complex Conservation Challenge

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Golden Eagles (Aquila chrysaetos) are currently the subject of considerable interest and concern. As evidence mounts that populations in western North America may be teetering on the brink of decline, pressure to increase take, both incidental to other activities and directly, is growing. As a consequence, effective conservation and management of golden eagles is increasingly important, but it is simultaneously increasingly complex. In this talk I will review information on some of the challenges the U.S. Fish and Wildlife Service and others are currently facing in the management of Golden Eagles in the United States

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Utilization Probability Map for Migrating Bald Eagles in Northeastern North America: A Tool for Siting Wind Energy Facilities and Other Flight Hazards

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Collisions with anthropogenic structures are a significant and well documented source of mortality for avian species worldwide. The Bald Eagle (Haliaeetus leucocephalus) is known to be vulnerable to collision with wind turbines and federal wind energy guidelines include an eagle risk assessment for new projects. To address the need for risk assessment, in this study, we 1) identified areas of northeastern North America utilized by migrating Bald Eagles, and 2) compared these with high wind-potential areas to identify potential risk of Bald Eagle collision with wind turbines. We captured and marked 17 resident and migrant Bald Eagles in the northern Chesapeake Bay between August 2007 and May 2009. We produced utilization distribution (UD) surfaces for 132 individual migration tracks using a dynamic Brownian bridge movement model and combined these to create a population wide UD surface with a 1 km cell size. We found eagle migration movements were concentrated within two main corridors along the Appalachian Mountains and the Atlantic Coast. Of the 3,123 wind turbines >100 m in height in the study area, 38% were located in UD 20, and 31% in UD 40. In the United States portion of the study area, commercially viable wind power classes overlapped with only 2% of the UD category 20 (i.e., the areas of highest use by migrating eagles) and 4% of UD category 40. This is encouraging because it suggests that wind energy development can still occur in the study area at sites that are most viable from a wind power perspective and are unlikely to cause significant mortality of migrating eagles. In siting new turbines, wind energy developers should avoid the high-use migration corridors (UD categories 20 & 40) and focus new wind energy projects on lower-risk areas (UD categories 60-100).

Northern Saw-whet Owl Nest Box Study in Nebraska

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Despite sporadic breeding season reports in Nebraska over the past 125 years, there has been no well-documented evidence reported previously for Northern Saw-whet Owls (Aegolius acadicus). This study was initiated to: 1) document breeding, 2) collect basic breeding information, and, 3) to ascertain the breeding range. Data collected in the first five years demonstrated breeding across a surprisingly large area in western and northern Nebraska.

Juvenile Dispersal Distances, Competition, Philopatry and Social Attraction: An Experiment with Spanish Imperial Eagles

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Juvenile dispersal is a fundamental process affecting abundance and distribution of species, population dynamics and persistence, and genetic flow. In the present study, we investigated juvenile dispersal strategy of a territorial long-lived species with deferred maturity, the Spanish Imperial Eagle (Aquila adalberti). Here we used a reintroduction program as an experimental approach to test separate predictions of the different hypotheses about juvenile dispersal movements. We examine the ontogeny of the movement behavior of radio tagged juvenile eagles throughout their first two years of life under three different scenarios: 1) tranlocated young released without adults in the area, 2) tranlocated young released with adults breeding in the area, and 3) wild non manipulated individuals. In the first two scenarios, ad libitum food was provided during six weeks before released, potentially improving nutritional condition of the young. In the wild young, non-supplementary food was provided. We showed that social attraction have a critical role in determining maximum dispersal distances as far as in absence of breeders in the area, young eagles almost double the normal distance of dispersal in wild young (from 132 km to 232 km). Those differences were significant also when comparing with released young with breeders in the area (from 154 km to 232 km), showing that the increase in Dmax was not related to management or ad libitum food. Also, it seems that the driver of Dmax is not familiarity with the natal area, but the attraction by breeders. Not only was Dmax larger in young released without breeders but distribution of Dmax changed from pronounced leptokurtic and positively skewed distribution to a normal distribution. Our results showed how both social attraction and wandering hypotheses act simultaneously determining the juvenile dispersal strategies of a territorial long-lived species, like the Spanish Imperial Eagle.

Males Keep at Home: Sex Ratio Adjustment as a Strategy to Optimize Colonization Processes

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Distortions in natal sex ratios of populations seem now to

be well established: sex ratio deviations cause variations in the survival of small and isolated populations. However, the effects of a skewed sex ratio in a metapopulation context have been poorly attended. Here we show for a species with sex-biased dispersal, the tendency to skew the sex ratio to the most philopatric sex in low-density populations, while favoring the production of the dispersive sex when population density increases under a metapopulational scenario. As the proportion of adults able to produce offspring will entail differences in population growth, a natal sex ratio that is able to increase the mating probability in the natal population will increase the survival of connected populations. The possibility to test dispersal pattern among individuals, natal sex ratio changes, and age of breeders in a reintroduced population of Osprey (Pandion halietus) in south of Spain reveals the opportunity to predict changes in population dynamics derivates of the population growth. Our results demonstrate that a differential natal dispersal between sexes will cause differences in population composition, and that a sex ratio deviation to males (the most philopatric sex) contributes to an increase of the natal population density. We anticipate our results to be a starting point for simulation models to predict viability of small, connected populations in dimorphic species.

European Sparrowhawk (Accipiter nisus) – a long term study

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This talk will summarize some of the findings from a 30-year study of Sparrowhawks in a 200 km2 area of south Scotland. Numbers remained fairly stable over the study period, remaining within 15% of the mean level throughout. In general, the numbers of breeders recruited each year matched the numbers lost from the previous year. On average, about half of all nests produced young, but this proportion varied greatly from year to year, largely according to weather. In marked individuals, breeding parameters improved from early to mid-life, then deteriorated in old age. Lifetime reproduction varied according to the breeding life of individuals, and about 5% of breeding females produced half the young arising from the population as a whole. Territories varied in quality, and individuals frequently changed territories. The good territories were heavily competed, and during their lives many individuals moved from poor to good territories. A change in territory was usually accompanied by a change of mate.

The Golden Eagle (Aquila chrysaetos) in Norway: Population Status, Management, Conflicts and Threats.

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Since 1788 there have been bounty systems on the Golden Eagle (GE) in Norway, and since 1845 these bounties have been paid for by the Norwegian state. However, the Golden Eagle was protected by law in 1968, and Norway has signed the Bern convention, for securing viable wild populations of listed animals and to protect them and their natural habitats, and the CITES and Bonn Conventions. The Golden Eagle was removed from the Norwegian Red List in 2006, and Norwegian law grants permission to kill Golden Eagle, under conditions where it is attacking livestock or semi-domesticated reindeer. Since 1995 five individuals have been killed out of ca. 20 permissions granted. During the last few years what appears to be a political campaign against large predators has become evident. As one MP stated in Parliament: "The population of Golden Eagle in Norway seems to be out of control, and is maybe of twice the size as it ought to be". The population size in 2003 was estimated at 850-1200 pairs, while 960 occupied territories were registered in 2010-2014 (the Red list limit is 1000 breeding pairs). Its main food is grouse and hares, with some lambs and reindeer calves taken during spring. GPS tagging has shown that young GEs move out of their natal areas during winter, and migrate southward to central and southern Sweden. On their return migration during spring they rarely move into reindeer calving areas. There is evidence of illegal killings during their migration. The adults are mainly stationary during the whole year. The GE is intensively monitored in 11 areas in Norway. The chick production is relatively low (0.2 – 0.4 fledglings per occupied territory). Current and future threats are power-lines, wind farms, illegal killing, depletion of food-base and poisoning from lead ammunition.

Home Range Size and Characteristics of Fields Used for Roosting and Foraging by Wintering Short-eared Owls (Asio flammeus) in New York State

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Home range size was examined for 31 Short-eared Owls present at traditional wintering locations in various parts of New York State during the winters of 2008/2009-2012/2013. Twenty-one of these owls had enough locations and showed sufficient site philopatry to accommodate the estimation of home ranges. Mean home range size was 217.7 ha (lower SE=173.6 ha, upper

SE=273.0 ha) and home range size ranged from 49.3-1256.1 ha. Ground roost locations used by these Short-eared Owls had significantly greater thatch depth, grass cover, maximum grass height, and maximum forb height, number of vertical strata, and vegetation diversity compared to both fields used only for foraging, and fields used for neither roosting nor foraging. Fields used for foraging had a significantly greater number of vole runways and significantly greater forb cover than either roost fields or non-use fields. Fields used for neither roosting or foraging had a significantly greater amount of bare ground compared to both fields used for roosting and fields used for foraging. Soil was inundated more frequently at roost sites than foraging sites and unsaturated more frequently at foraging sites than at roost sites.

The Raptor Population Index – Ten Years Beyond the State of North American Birds of Prey

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The Raptor Population Index (RPI) partnership includes the Hawk Migration Association of North America, Hawk Mountain Sanctuary, HawkWatch International, and Bird Studies Canada. The RPI was formed in 2003, with the goal of using migration count data to assess trends in North American raptor populations in a standardized way. Through the RPI project, hawk-watching has become a major citizen-science based effort that contributes to raptor conservation. In 2008 RPI produced the State of North America's Birds of Prey, a volume that summarized trends in count data from 21 migration watch sites using historical data collected through 2004. This paper highlights the results of the latest RPI update including data through 2014 for over 60 count sites, and available on-line at rpi-project.org. Results are synthesized regionally by species and we compare migration count trends from the 2008 book to those that include an additional decade of monitoring data as well as data from additional watch sites.

Thirty three Years of Hawk Watching in the New York Metropolitan Area

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Review of what has been learned about hawk migration from 33 yrs of counting hawks at six watch sites in New York, New Jersey, and Connecticut. For individual hawk species, distribution tables reveal regional trends and patterns across the metropolitan area. The sources of variation in the data that are addressed include wind and weather patterns.

The First Full-Season of Spring Migration Counts at North America's Northernmost Migration Site: Gunsight Mountain, Alaska

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The migration of Alaska's raptors has not been well documented. However Gunsight Mountain in south-central Alaska, has been a well-known spring migration corridor since the 1970s. Sporadic counts were conducted in the 1980s, establishing the valley as a corridor for significant numbers of Golden Eagles (Aquila chrysaetos), and several years of incomplete counts were conducted between 2003 – 2009. However, a full season migration count has never been conducted. This knowledge gap, coupled with uncertainty over the population size and status of the Alaska's Golden Eagles, led to a collaborative effort to conduct the first full season of standardized migration counts in the spring of 2016. We conducted over 500 hrs of migration monitoring from March 7 – May 15, 2016 using established HawkWatch International migration protocols. Golden Eagle passage peaked the third week of March while Buteo passage peaked the second week of April. We counted over 1,000 Red-tailed Hawks (Buteo jamaicensis), of which over 95% were of the harlani subspecies, the highest number and proportion of any site in North America. We also counted over 1,100 migrating Golden Eagles. Satellite telemetry data from Alaska Department of Fish and Game and the U.S. Fish and Wildlife Service on adult Golden Eagles trapped at Gunsight Mountain, suggest individuals breed in south-central Alaska over a relatively small proportion of the state's total area, thus providing additional evidence that Alaska's state population estimate

of 2,500 individuals has been greatly underestimated. We propose to conduct at least two additional years of migration monitoring to capture the between-year variation in count totals, particularly for Golden Eagles, to better inform a state population estimate for Alaska and to establish a baseline for future monitoring efforts. We also propose to combine Golden Eagle satellite telemetry and count data to estimate breeding density for portions of south-central Alaska.

2016 Short-eared Owl (Asio flammeus) Citizen Science Breeding Survey Results from the Intermountain West

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North American Short-eared Owl populations are thought to be experiencing long-term, range-wide declines in abundance. Loss of native Great Plains grasslands and Intermountain West shrublands are hypothesized to be the leading cause of population declines, however direct evidence for this is unclear, and the magnitude of population declines remains unknown due to historically poor survey data. In response to these concerns, a targeted citizen science-based Short-eared Owl breeding survey was conducting during the 2016 breeding season in Idaho and Utah. Our primary objectives were to identify Short-eared Owl habitat associations and generate statewide abundance estimates. More than 150 volunteer citizen scientists and professionals conducted spatially-balanced, evening point-transect surveys in 108 sampling areas for breeding Short-eared Owls from March – May 2016. Surveys were coordinated and conducted at the state-stratum to promote local management and conservation recommendations and promote high-quality data collection from local volunteers. Conducting surveys at the state-stratum also allowed for the assessment of important state-by-state differences and similarities in Short-eared Owl habitat associations, distribution, abundance, and volunteer recruitment. These similarities and differences will help inform our proposed project expansion to the Western Flyway Short-eared Owl breeding range, which would include eight participating states. Due to high annual variability in breeding distribution and abundance, a broad multi-state survey implemented consistently over multiple years may be required to meet project objectives.

Simple Problem, Simple Solution, Difficult Transition – Getting the Lead Out

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Most single-species conservation efforts begin with observations that lead to questions or a series of questions followed by rigorous scientific inquiry to narrow down primary impediments to a species survival and hopefully eventual recovery. Scientific foundations of such programs are but building blocks of the full complement of conservation. Foundational studies alone rarely elicit the necessary change to ameliorate problems identified by initial science. It is what we do with scientific products – its packaging – that engenders public response. The toxicity of lead ammunition residues to humans and wildlife is widely known within the scientific community, and corroborating studies abound. Whether a population-limiting effect for a species like the California Condor (Gymnogyps californianus), or a nagging, persistent assault upon the symbol of our nation the Bald Eagle (Haliaeetus leucocephalus), the threat is well defined and avoidable. We continue to observe unsustainably high levels of lead exposure in reintroduced California Condors in California and Arizona where both voluntary and mandatory measures are in place. What is it going to take? State, Federal, private non-profits, and conservation minded hunters are working together in Arizona and southern Utah to navigate this lead-reduction effort resulting in impressive rates of reported participation in big-game hunts. However, nearly thirty percent of free-foraging condors trapped and tested in 2015-16 trapping season had blood-lead levels warranting treatment, and radiographic evidence points to other forms of ammunition i.e. shotgun pellets and intact, small caliber bullets as potential sources. Small game and varmint hunters are now sought to participate in lead reduction efforts similar to that of the big game program.

Vultures – Now the Most Threatened Group of Birds in the World

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It is a staggering fact that a group of birds that two decades ago were often numbered in their millions is now the most threatened group in the world. Both New World and Old World Vultures have declined at an alarming rate. In south Asia the main cause has been non-steroidal anti-

inflammatory drugs (NSAIDs), which have poisoned millions of birds and resulted in three species of Gyps vultures to be listed as critically endangered, with other species now appearing to be affected as well. In Africa thousands of vultures, as well as unnumbered other scavengers are poisoned by poachers. Once numbers decline other factors such as the use of vulture body parts for tribal medicine starts to have an effect. Electrocution is common in many areas. In Spain, over one thousand Eurasian Griffon Vultures (Gyps fulvus) are killed yearly by wind turbines. We know that vultures are responsible for consuming more dead game than all the large carnivores in the Serengeti Plains. What can be done to mitigate the situation and what effects will this drastic decline have long term?

Transmitter Influences on Raptor Agility and Prey Capture

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Remote sensing technology (i.e. VHF radios, GPS transponders, etc.) has become an important tool for many studies conducted in wildlife research. The direct effects of the added weight from these transmitters are, however, poorly understood especially for birds. For predatory volant species, the addition of weight could be deleterious to agility and result in reduced prey capture capabilities. We investigated the potential impacts of transmitter weight on raptor agility through indoor flight trials with a trained Harris's Hawk (Parabuteo unicinctus). In these trials we recorded the flight paths of the trained hawk as she flew around a corner. During the trials she was fitted with mock transmitters weighing 0.4, 2.3, and 5.2% of her body weight. Pending further analysis we plan to present the velocity, acceleration, and curvature of the flights as related to weight loading. To further investigate the influence of transmitters on raptor predatory behavior we used nest cameras to record prey deliveries at Swainson's Hawk (Buteo swainsoni) nests in Potter and Carson counties near Amarillo, TX. We monitored five nests in which one adult was fitted with a PTT transmitter, and 6 nests in which neither adult was fitted with a transmitter. Following analysis of video footage we will present our findings regarding parental provisioning rates and diversity of prey species in context of transmittered and non-transmittered parents.

Federal Migratory Bird Banding Permits 101: Back to the Basics

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Historically, the banding (or ringing if you are in Europe) and auxiliary marking of migratory birds, including raptors, has provided much of the foundational knowledge within the field of ornithology. This is as true today as it was during the fledgling years of the Raptor Research Foundation five decades ago. The federal bird banding system (and the U.S.G.S. Bird Banding Laboratory itself) has continued to evolve through the years, concurrent with advances in telemetry and computer technologies, data management, and meaningful statistical analyses of this unique and invaluable dataset. Currently, the federal bird banding system is being evaluated and improved through a quality control and improvement process that involves all parts of the system (including, but not limited to: permit application review and management, data quality control and verification efforts, more efficient management of auxiliary marker authorizations, and advancements in the Band-It electronic information system). However, there still remains a large amount of misunderstanding and false perceptions amongst the ornithological community (including raptor biologists and researchers), especially in relation to the fundamental basis for the federal banding system – that is Federal migratory bird banding permits. This presentation will provide attendees with a detailed overview of the Master Bander permit (and sub-permittee) application process and the necessary requirements, provide a better understanding of the requirements for the use of auxiliary markers (colored leg bands, satellite transmitters, and other tools), authorizations to use various live-capture methods, and the input and revision of bird banding data by permit holders.

Potential Effects of Using Machine Vision Monitoring to Estimate Eagle Fatality Risk at Wind Facilities

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Because of concerns about potential strike-risk from wind turbines, much emphasis has been placed on obtaining accurate and reliable estimates of eagle activity at prospective and operational wind facilities. Projected collision risk for a specific wind project is typically measured using the U.S. Fish & Wildlife (USFWS) Bayesian Model, which incorporates priors based on external projects to relate eagle activity to risk and is parameterized by

site-specific eagle counts. However, the model is highly sensitive to survey effort, which can be limited when using standard point-count surveys by biologists. Recent machine vision technology offers an opportunity for substantially increasing survey effort and could therefore influence predicted risk estimates as a function of effort alone. We conducted a series of simulation studies based on the monitoring capabilities of a newly-developed machine vision system, IdentiFlight (Renewable Energy Systems), under varied expected conditions to determine how automated monitoring could affect strike-risk estimates. Results showed that risk estimates were markedly lowered as compared to using standard point-count methods, particularly under conditions where eagles were not observed on site or were temporarily using the site (e.g. migratory periods, subadult wandering). The potential regulatory and economic impacts of using machine vision monitoring at planned and operational wind facilities are discussed in the context of the USFWS Eagle Conservation Plan Guidance recommendations.

Flight Response to Topographic, Vegetative, and Temporal Correlates Predicts Risk from Wind Turbines to an Obligate-Soaring Bird, the California Condor

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Wind power is a fast-growing energy resource in the United States, and the state of California is a national leader in wind energy development. However, wind turbines can kill volant species, and the flight behavior of soaring birds can place them at risk of collision with these structures. We analyzed altitudinal data from GPS telemetry of critically-endangered California Condors (Gymnogyps californianus) to assess the circumstances under which their flight behavior may place them at risk from collision with wind turbines. We examined the types of terrain and land cover over which condors flew, and daily and seasonal patterns in flight behaviors. We also evaluated flight behavior in the context of distances to wind resources preferred by wind energy developers. Our preliminary results indicate that condor flight behavior was strongly influenced by topography and cover, such that birds flew at lower altitudes when over ridge lines and steep slopes and over forested and grassland cover types. Condor flight behavior also was strongly cyclical, such that birds flew lower during early morning and evening hours and during the winter months, when thermal updrafts were weakest. Although condors infrequently flew at altitudes placing them in the rotor-swept zone of modern horizontal-axis wind turbines, they did fly regularly near or within wind resources preferred by energy developers. The strong response of condors to variation in the spatial and temporal updraft environment they experience provides insight into risk management for this species. Our analyses indicate that this risk varies seasonally and may be greatest when condors fly over areas with high topographic relief and from turbines placed near their nocturnal roosting sites. In contrast, risk should be relatively lower when condors fly over less rough areas and from turbines placed in habitat they use during daytime soaring.

Belize Offshore: Southernmost Breeding Ospreys in the Western Hemisphere

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In February-March 2014-2016, we surveyed portions of the offshore Belize coastal zone, finding 25 active Osprey (Pandion haliaetus) nests: 10 in the Turneffe Is., and 15 from Dangriga south to Placencia. We also know of several active nests at Glovers Reef, and estimate Belize's maximum active nest count to be between 40 and 50. All of these are many miles east of the mainland shore in zones of coralline and mangrove keys: a region ~241 km long, from 18 degrees to 16 degrees N latitude. This nonmigratory, white-headed, Caribbean subspecies (P. h. ridgewayi) nests at very low density and far from the mainland. No active Osprey nests are known south of Belize along the east coast of Central and South America. Kleptoparasitism by Magnificent Frigatebirds (Fregata magnificens) is hypothesized to be among the factors that limit this population. We very seldom encounter the migrant subspecies (P. h. carolinensis) on our surveys, and we think they avoid this region to avoid kleptoparasitism. Reproduction is a small fraction of that typical in migratory, temperate-zone P. h. carolinensis, probably ranging from 0.3-0.5 young fledged/active nest, based on our limited sample. We believe that for this southernmost tropical population to be marginally stable, annual adult survivorship must be substantially higher than that of the migratory subspecies, 90% plus, and mean age at first breeding must be lower, 3 years of age or occasionally even less. This inexperience could contribute to the high nest failure rate. Most nests are in mangroves, and their site instability also reduces reproductive success.

Provision of high nest platforms at strategic sites is a management and educational option. Population models will be presented and discussed.

Nest Defense and Alarm Calling in Burrowing Owls (Athene cunicularia) Varies by Predator Type and Virulence

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Burrowing Owl nests are vulnerable to predation by many mammalian and avian predators. Therefore, the owls defend their nests by altering their position, posture, flights, and aggression. They also frequently give alarm calls containing a series of monosyllabic notes uttered in rapid succession. This study sought to determine if and how nest defense by Burrowing Owls differed among predators that varied in their threat to nests. It was also of interest to determine if alarm calls uttered in response to different predators varied such that information about the nature of the threat could be communicated with conspecifics. We used trail cameras to record nest predators visiting Burrowing Owl nests in the Morley Nelson Snake River Birds of Prey National Conservation Area in southern Idaho, and designed controlled experiments with predators that differed in virulence. We considered the most virulent predators to be those that could both plunder nests and kill adults. We exposed Burrowing Owls to models of Coyotes (Canis latrans), American Badgers (Taxidea taxus), Common Ravens (Corvus corax), Great Horned Owls (Bubo virginianus), and a control (Long-Billed Curlews, Numenius americanus), and made video and audio recordings of trials with which we assessed behavioral and vocal responses. We analyzed Burrowing Owl behavioral responses to nest predators including distance of approach and number of head bobs, hovers, and strikes. We also measured bout duration, notes per bout, inter-note interval, note duration, and frequency of call notes in the alarm calls. We found that both behavioral responses of Burrowing Owls and characteristics of alarm calls differed in relation to predator type and discuss the implications of these results for understanding how selection has operated on Burrowing Owl behavior.

Timber Harvest and Tree Size Near Nests Explains Variation in Nest Site Occupancy but Not Productivity in Northern Goshawks (Accipiter gentilis)

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Conservation concern for the Northern Goshawk reflects evidence that goshawks may abandon nest sites or suffer from reduced nesting success in response to some forms of timber harvest. However, this evidence is mixed and has yet to be reviewed systemically and quantitatively. Therefore, we conducted a meta-analysis to assess the extent to which timber harvest and tree size explain variation in goshawk productivity and site occupancy. Goshawk productivity was not significantly explained by the presence of nearby timber harvest nor by the average size of nearby trees either in North America, in Eurasia, or when averaged across all studies. However, timber harvest and tree size together more strongly explained goshawk occupancy of nest sites or territories. Within studies, goshawk nest sites or territories with less timber harvest nearby or relatively larger trees were, in most cases, more likely to be occupied; this pattern applied to both continents. Our results suggest that, although both timber harvest and a lack of large trees are associated with lower occupancy by nesting goshawks, pairs that nest near timber harvest or in small trees have indistinguishable nesting success from pairs nesting in large trees or farther from timber harvest. We found substantial heterogeneity in results among studies, especially within North America, which is not surprising given that studies differed greatly in research methods, forest type, and forest management. Our results suggest Northern Goshawk nest sites in populations of conservation concern may need more protection from timber harvest than they are currently receiving. Equally important, to better understand effects of forest management on goshawks, we recommend additional studies designed to: 1) better identify the spatial and temporal extent of the effect of timber harvest on goshawk site occupancy; and 2) determine what goshawks do and where they go after a timber harvest.

The Do's and Don'ts of Handling and Restraining Raptors

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Capturing, handling, and restraining are essential skills for researchers involved in marking, identifying, translocating, and/or collecting biomedical samples in birds of prey. These researchers are responsible for the overall physical and mental condition of the captured birds. An adequate training in raptor handling and restraining is key to ensure the birds' safety, minimize the birds' stress, collect adequate

data, and allow the rapid release of the birds. Furthermore, inadequate handling and restraint, sometimes accompanied by disregard for safety and protective measures, are the main causes for handler injury, sometimes with severe, and even fatal, consequences. While there are numerous technical and educational materials available that discuss and illustrate raptor capturing techniques, there is a scarcity of information about appropriate handling and restraining of Falconiformes and Strigiformes. The main goal of this presentation is to discuss and demonstrate field handling and restraining techniques applicable to a broad number of raptor species, including eagles, vultures, hawks, kites, and owls. Adequate execution of these techniques will allow raptor researchers to accomplish their goals in an efficient and safe manner.

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50 Years of Advancement in Raptor Science and Conservation in East Asia

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East Asia has more than 200 species of diurnal and nocturnal raptors. A number of these have highly restricted ranges. The ecology and reproduction of some species are well known, but most are not. Modern research on raptors has only existed in the last 30 yrs. Even during the large scale and fairly long term Migratory Animal Pathological Survey of the late 1960s to early 1970s, raptors were poorly covered. The 1970s saw some localized conservation efforts, but the international specimen trade and habitat destruction were widespread. Serious research began in the 1980s in some countries. Major efforts have been devoted to learning the ecology, reproduction, and migration of select species. Some of these studies are recent, while others have continued for several decades. Banding, color marking, field observations, infrared triggered cameras, video recording, radio tracking, satellite tracking, and habitat mapping are some of the methods used by current researchers. The formation of the Asian Raptor Research and Conservation Network (ARRCN) in 1998 has been instrumental in encouraging students and young scientists to focus on raptors and to strengthen international collaboration. Since 1998, nine ARRCN conferences have been held in nine Asian countries to facilitate cooperation and information exchange. Using information contributed by its members, ARRCN recently published a volume on the resident raptors of Asia. The second volume on migratory species is under preparation, and should be out soon. This network now has more than 200 members from 22 Asian countries and 10 western countries. Although there are still gaps in East Asia with no one working on raptors, growing interests and concerns for raptors no doubt will see major growth in both research and conservation in the coming 50 yrs.

Research Recommendations for Understanding the Decline of American Kestrels (Falco sparverius) Across Much of North America

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The charismatic nature and enigmatic decline of the American Kestrel has sparked interest and concern from citizen and professional scientists, as well as the general public. Although several reasons have been proposed for the cause of the decline, there is little or no empirical evidence for hypothesized threats, and management options are unclear. We present recommendations for future research into the cause of decline for American Kestrels to inform priorities regarding monitoring, identifying drivers of survival and reproductive rates, and creating full-annual-cycle models. Breeding Bird Survey data suggest that kestrel declines have been occurring steadily since at least 1966; therefore, specific threats that have arisen in recent decades are unlikely to be the ultimate cause of the decline. Nest cavities also do not seem to be limiting many populations, as evidenced by the low occupancy of many nest box programs. The most parsimonious demographic mechanism of decline seems to be that vital rates have been at constant levels that are too low to maintain populations since at least the late 1960s. But, the large range and complicated biology of the American Kestrel make simple, continent-wide drivers of decline unlikely, and potential weaknesses of monitoring programs can confound inference into the spatial and temporal scope of declines. Research regarding phenology, migratory connectivity, and use of natural nest cavities will improve monitoring of American Kestrels and thereby improve our understanding of population declines. Full-annual-cycle, demographic studies of the American Kestrel are also sorely needed, as are studies of breeding success in natural cavities, effects of climate change, and identification of important wintering and migration sites outside of the U.S.A.

A Retrospective Look at the Survival of Birds of Prey Released from a Rehabilitation Center in North Carolina

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Wildlife rehabilitation is a rewarding and fulfilling part of veterinary medicine. However, the actual long-term effectiveness of rehabilitation is difficult to assess, and many suggest that the success rate is so low that the practice of wildlife rehabilitation is not worth the effort. Studies with telemetry devices have proven that long-term survival is possible, but there is little definitive data. Another method with which to assess long-term survival is the analysis of band reports from birds released with permanent leg bands. Here, I report the findings of an analysis of band report data from birds of prey released from a rehabilitation center in North Carolina, USA over a 30 yr period. All birds released from this center were identified with a permanent leg band, and band report data was collected by the US Fish and Wildlife Service. The survival times were analyzed based on the original injury and species. Results indicate that rehabilitation after even severe injuries can be effective and is a worthwhile endeavor.

Urban Ecology of Mississippi Kites (Ictinia mississippiensis)

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Mississippi Kites have an extensive presence in the Southern Great Plains of the United States where they breed in rural shelterbelts, riparian corridors, mature shrub lands, and urban areas. Concurrent studies of their reproductive biology in western Texas suggests that kites breeding in urban environments receive reproductive benefits over exurban breeding birds. Urban-nesting kites consistently have greater reproductive success, productivity, and earlier nest initiation dates than their exurban counterparts. Urban kites also breed in closer proximity to one another and re-occupy nest-sites more frequently than individuals in exurban areas, suggesting that urban populations are denser and more stable than exurban populations. Lastly, urban kites are more tolerant of humans near nesting areas compared to exurban kites. These observations suggest that Mississippi Kites are highly adaptable to urban environments.

Blood Lead Levels of Piscivorous Raptors in the Coastal Plain of Virginia

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Since the ban of dichlorodiphenyltrichloroethane (DDT) in the United States, breeding populations of Osprey (Pandion haliaetus) and Bald Eagles (Haliaeetus leucocephalus) in the Chesapeake Bay and its tributaries have increased substantially. However, these species are still exposed to several potential sources of contamination including lead. To examine species-specific, spatial, and age related patterns in lead exposure and to identify the specific mechanisms of this exposure, we captured and tested 141 free-flying individuals and nestlings. Preliminary results suggest that blood lead levels of free flying osprey ($n = 8$, $\bar{x} = .13$ ppm) were higher then those of nestlings ($n = 82$, $\bar{x} = .02$ ppm). Blood lead levels of nestling bald eagles ($n = 14$, $\bar{x} = 0$ ppm) were below detection limits ($n = 37$, $\bar{x} = 0$ ppm) and only three free-flying birds had measurable blood lead levels. Identifying pathways of lead exposure in these species presents opportunities for improved management of anthropogenic lead sources, and its impacts to wildlife and humans in Virginia.

35 Years of Snowy Owl (Bubo scandiacus) Observations, Banding and Airport Relocation in Massachusetts

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Since 1981, >700 Snowy Owls have been banded and relocated from Logan International Airport in Boston, MA. Owls usually arrive in early November and leave by the end of April. The earliest arrival date is October 22 and latest record was July 7, until 2014 when two wintering Snowy Owls remained through the subsequent autumn at Logan Airport and the nearby Boston Harbor islands, providing Massachusetts' first summer record for this species. Overall, most owls have been in good body condition. Prey items were determined through observation (including use of night-vision equipment after dark) and examination of >6000 food pellets. On a number of occasions, Snowy Owls have been observed feeding on carrion and even other Snowy Owls. They are very fast for a large owl and often prefer to take their prey while in flight like large falcons. Unlike on the breeding grounds, wintering Snowy Owls usually hunt nocturnally, and have been observed capturing meadow voles hidden under >15 cm of snow by hovering, listening, and plunging despite the overwhelming

noise of the airport. Relocated owls were color marked with a temporary dye on the back of the head and were documented throughout New England, eastern Canada, and along the Atlantic coast. Banded owls have returned to the airport up to 23 years after they were originally banded. Some individuals tagged with PTTs at Logan Airport have been tracked >11,200 km in nine months to the breeding grounds in the Arctic and back.

Connecticut Osprey Reproduction as a Bioindicator of Migratory Atlantic Menhaden Abundance

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In 2014-2016, I studied Osprey (Pandion haliaetus) nest success from hatch to fledge at the famous Connecticut River Estuary (CRE) Osprey colony. This accessible, platform-nesting colony was the site of classic DDT impact studies from the 1950's through the 1970's. Migratory Atlantic Menhaden (Brevoortia tyrannus) arrive in Long Island Sound (NY-CT) in May. As abundant schooling planktivores and prey species, Menhaden perform unique, precious ecosystem functions. In June-July 2014 and 2015, the nestling period, Menhaden comprised nearly 100% of CRE Osprey diet. This resulted in very large fledging brood sizes, mean ~2.5 young/successful nest, and a high nest density in the CRE. Menhaden are subject to the intense commercial harvest of the "reduction fishery" in Virginia and some other waters. The Atlantic States Marine Fishery Commission (ASMFC) sets harvest quotas, and currently they have requested ecological data to assess Menhadens' ecosystem function and value. I argue that local Osprey nest density and reproduction (large "Menhaden/Osprey colonies", current and historical) should be part of those parameters. Many non-governmental organizations (NGOs) promote harvest quotas that will restore Menhadens' former abundance and ecological value in New England/New York coastal waters.

Juvenile Pallas's Fish Eagle Migration in Asia

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Pallas's Fish Eagle (Haliaeetus leucoryphus) is a globally vulnerable species with a decreasing population trend. The species' historical range extended from the Caspian Sea to China and from Russia to the Indian Subcontinent. However, seasonal movements and migration patterns are complex and severely data deficient. Conflicting observations suggest the potential for three separate breeding migrant populations located in Mongolia, China, and India, whose ranges overlap around the Himalayas with inverse breeding seasons based upon climatic factors, such as the timing of spring thaw and the onset of the East Indian monsoon. During the summer of 2013, a 70g GSM-GPS transmitter backpack was attached to a juvenile Pallas's Fish Eagle at Ogii Nuur, Mongolia. In February 2014, an additional two 70g GSM-GPS transmitters were deployed on first year juvenile Pallas's Fish Eagles in Kaziranga National Park, Assam, India. Over the duration of 2013 - 2015, we were able to accumulate four full fall migration datasets from all tagged individuals. From 2014 - 2016, we collected an additional four spring migration datasets. All migration data was analyzed to determine connectivity, phenology, and site fidelity between the northern and southern tagged individuals. We also assessed the potential impact of weather upon the initiation of migration, such as the onset of the monsoon. Results indicate a potential connectivity between the sampled populations in Mongolia and India. In addition, there was a significant overlap in migration route and timing for all tagged individuals across multiple years. This study provides vital baseline data for future conservation efforts and gives groundbreaking insight into the migration ecology of this data-deficient and declining species.

Recovery of the Bald Eagle in the Conterminous 48 States

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Bald Eagle (Haliaeetus leucocephalus) populations probably started to decline soon after Europeans began to invade the North American continent. Large-scale loss of habitat, indiscriminant killing, and pesticide poisoning had placed the species on a near-extinction trajectory. Charles Broley sounded one of the first alarms in the 1950's, and a National Audubon analysis indicated that just over 400 breeding pairs remained in the 48 conterminous states in 1963. Bald Eagles were protected by the 1940 Bald and Golden Eagle Protection Act, and the 1967 precursor to the Endangered Species Act, but recovery of Bald Eagle populations truly began with the ban on DDT in 1972. The "southern" subspecies of Bald Eagle was one of the original species protected by the Endangered Species Act when it was enacted in 1973. Protection under the Act was extended to all Bald Eagles in the conterminous 48 states in 1978.

Soon after, five Recovery Teams were established covering the entire 48-state area. The teams developed plans that outlined tasks necessary to recover the species: habitat protection, population monitoring, law enforcement, and population enhancement and restoration. These combined efforts of countless federal, state, and private organizations and individuals over the past 50 years have resulted in a dramatic reversal of the early eagle population trend to one now of substantial increase and growth. In 1995 eagles were reclassified from endangered to threatened in 43 states, and in 2007 the Bald Eagle was completely removed from the federal Endangered Species List.

Supervised Classification of Accelerometry Data Distinguishes Raptor Flight Behaviors

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Energetic constraints can play a substantial role in determining the ecological interactions, geographic distribution, and movement behaviors of flying birds. Raptors often balance their energetic costs by alternating among flapping, soaring, and gliding flight. Recent technological developments allow miniaturization of accelerometers that can measure movement in enough detail to quantify flight behavior. However, models to interpret accelerometry data are not well-developed, rarely trained with classified data, and difficult to apply. We collected accelerometry data at 140 Hz (measurements per second) from a telemetry unit on a Golden Eagle (Aquila chrysaetos) whose flight was recorded with video as a mechanism to optimize supervised classification algorithms for accelerometer data. The two forms of supervised classifications we preliminarily applied, random forest (RF) models and K- nearest neighbor (KNN), were both highly accurate in classifying basic behaviors such as flapping (85.5% and 83.2% accurate, respectively), soaring (92.8% and 87.3%), and sitting (84.1% and 88.9%) with overall accuracies of 86.9% and 92.3% respectively. However, more detailed classification schemes, with specific behaviors such as banking and straight flight, mantling, wing tucks, and wing beats, were well classified by the KNN model (90.83% accurate), but not well classified with the RF model (64.13%). Importantly, the KNN model is substantially easier to implement than the RF approach. Finally, we demonstrate application of these supervised classification algorithms to accelerometer data from free ranging birds to show their potential use in studies of raptor behavior.

Keeping Raptor Researchers and Volunteers Save

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It is imperative that safety protocols on the handling of live and dead raptors be followed at all times, but knowing more about avian diseases, and having a reference manual available on your cell phone can reduce the stress of doing so. Recognizing external symptoms of poisoning, avian dry pox, electrocutions, ectoparasites, etc. is useful to banders. Knowing when to stop work and call in additional resources because a bird may be hazardous to human health is essential for the safety of researchers and banding volunteers. This talk is a world-wind tour of possible causes of avian mortalities plus how to access this on-line resource: http://beatymuseum.ubc.ca/birds (Part 13). This free downloadable manual in photo-essay format helps researchers recognize benign tissue abnormalities (drowning, gout, collisions, hunting wounds, etc.) and those that could be a human health risk (some poisons, trichomonas, avian TB, etc.). The presentation includes information on what additional symptoms to look for, what to photograph, what samples a pathologist might request, and when to stop work immediately! This cell phone accessible resource does not replace the need to consult a qualified Avian Pathologist - but does give researchers, banders, and citizen scientist the vocabulary to more accurately describe raptor injuries and avian diseases.

Recovery of Arctic Peregrine Falcons (Falco peregrinus tundrius) along the Colville River, Alaska, 1981-2011

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Peregrine Falcon populations declined globally from widespread use of organochlorine pesticides during the latter half of the twentieth century. We documented the abundance and reproductive performance of cliff-nesting Arctic Peregrine Falcons by surveying the same 347 km of the Colville River in northern Alaska from 1981–2011. Overall abundance increased from 24 to 61 pairs from 1981–1994, and stabilized around a mean of 56.7 pairs after 1994. Rate of population growth, clutch size, brood size, and productivity were similar to those of other

recovering populations of Peregrine Falcons. Higher productivity was associated with nests in the southern portion of the study area, nests that were protected from above, and nests with earlier hatch dates. Productivity also declined over time, which we attribute to an increasing proportion of lower quality territories used as the population recovered. This suggests a density-dependent effect upon fecundity, consistent with the habitat heterogeneity hypothesis, wherein a higher proportion of individuals occupy poor quality habitat at high density than at lower density.

Status of the Short-eared Owl (Asio flammeus) in Alberta, Monitoring Nomadic Invasions

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The Short-eared Owl mainly inhabits the Grassland Natural Region and, to a lesser extent, the Parkland, Boreal, and Foothills in Alberta. Being a nomadic species, large numbers of Short-eared Owls may roost and forage together in areas where food is abundant. In 1996, the Short-eared Owl's status was changed from secure to the "Blue List" because it was felt that the species may be at risk. In 2001, the Short-eared Owl was provincially designated "May Be At Risk" due to declines in all prairie province populations and in populations of other parts of the North American range. The Short-eared Owl remains designated as "May Be At Risk" because the causes of population decline are unknown, the irruptive nature of the population makes population trend assessments extremely difficult, and, therefore, data is lacking. For instance, while there have been many documented irruption events, relatively few nesting records exist for Short-eared Owls in Alberta. Over the past few decades, tracking and documentation of Short-eared Owl irruptions have been greatly improved with the introduction of citizen science programs. Here, we provide updates on irruptions that have occurred in Alberta.

Irruptive Movements in Snowy Owls, A Specialized Predator Exploiting a Pulsed Resource.

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Both on its breeding and wintering grounds, the Snowy Owl (Bubo scandiacus) is an irruptive visitor, invading a given site every three to five years while being seldom seen between those years. These irruptive movements have long been thought to be linked with food availability. We assessed two alternative hypotheses to explain the periodic irruptions of Snowy Owls: (a) the lack-of food hypothesis, which states that a crash in small mammal abundance on the Arctic breeding grounds forces owls to move massively in search of food; (b) the breeding-success hypothesis, which states that a high abundance of small mammals during the summer allows for high production of young, thus increasing the pool of migrants moving south the following winter. In addition to our long-term monitoring of breeding density in the Arctic, we modeled winter irruptions of Snowy Owls using citizen-based Christmas Bird Counts from 1994 to 2011 in relation to summer abundance of small mammals from two distant breeding sites in North America. We also evaluated age class composition of wintering Snowy Owls in temperate North America using high-resolution pictures. Winter owl abundance in temperate North America was positively related to prey abundance during the previous summer at both Arctic sites. Moreover, the proportion of juveniles measured in winter irruptive Snowy Owls was high, suggesting that irruptive movements are caused, at least in this species, by good breeding conditions on the Arctic breeding grounds. Irruptive migration of Snowy Owls was therefore best explained by the breeding success hypothesis and was apparently caused by large-scale summer variations in food availability.

Reducing Lead Poisoning Through Hunter and Angler Outreach

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Poisoning from spent lead ammunition has been documented in many species worldwide and is an issue that occurs repeatedly in Atlantic Canada in the Bald Eagle (Haliaeetus leucocephalus). Water birds such as Common Loons (Gavia immer) are regularly poisoned by discarded fishing tackle. An effective way to decrease the incidence of lead poisoning in wildlife is hunter and angler education to encourage transition to non-lead ammunition and tackle. In 2012, the Cobequid Wildlife Rehabilitation Centre in Nova Scotia started a science based outreach program for hunters and anglers encouraging voluntary transition to non-lead ammunition and angling tackle. This ongoing effort has resulted in positive and ground-breaking results

and initiatives in Atlantic Canada, including a non-lead ammunition and angling tackle exchange program. This discussion will summarize the main points, progression and continuation of this program. When outreach is delivered in a manner that seeks common ground, cooperation between groups can result in positive change and a solution to this solvable problem.

Scavenging as a Food Acquisition Strategy by Peregrine Falcons During the Nonbreeding Season in Coastal Washington

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Although best known for capturing avian and other prey, five of the six North American falcon species are documented facultative scavengers: American Kestrel (Falco spaverius), Merlin (F. columbarius), Prairie Falcon (F. mexicanus), Peregrine Falcon (F. peregrinus) and Gyrfalcon (F. rusticolus). We observed Peregrine Falcons during 1,109 vehicle surveys of three coastal beaches in Washington State between 1983 and 2015. Beginning in 1995, we captured and color banded 192 Peregrine Falcons for individual identification. During the study, we made 201 observations of Peregrine Falcons hunting and 212 observations of feeding. Excluding records of Peregrine Falcons with food items of unknown origin (n = 49), we observed falcons with food items 163 times, including prey that we concluded the falcons had captured (n = 70), followed by carrion-feeding (n = 49), and prey that we saw being captured (n = 44). Carrion-feeding represented 30% of our observations involving Peregrine Falcons with food items in these three categories. Our observations of carrion-feeding by Peregrine Falcons included food items representing 20 taxa; the median biomass of species represented by carrion was greater than for species we saw being captured. Carrion included a variety of species, among the most unusual being Brown Pelican (Pelecanus occidentalis), Great Blue Heron (Ardea herodias), Harbor Seal (Phoca vitulina) and Beaver (Castor canadensis). We saw scavenging by 21 color-banded individuals, 8 of these on more than one occasion. In this presentation, we will evaluate whether scavenging was more prevalent with respect to season or as a function of falcon age. Given the frequency of carrion feeding, the biomass of carrion potentially consumed, and the predictable presence of carrion on the study area, we conclude that scavenging by Peregrine Falcons in Washington State is neither rare nor opportunistic, and that carrion represents a common and important source of food.

A History of Raptor Research Foundation Conferences

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Since its beginning 50 yrs ago, the Raptor Research Foundation has held 63 conferences in nine countries. The US has held 51 conferences, Canada and Mexico have held three each, and one conference each have been held in Argentina, Scotland, England, Spain, Israel and the Czech Republic. South Dakota holds the distinction of having held more conferences than any other US state (11), followed by Minnesota (6), California (4), and Idaho and Pennsylvania each with three. The South Dakota conferences took place during the formative years of RRF; these were largely focused on efforts to develop captive breeding techniques for the Peregrine Falcon during its precipitous decline. I will share a history of conference locations and hosts, including conferences held jointly with other organizations, describe the basic format of an RRF conference, and tell how RRF conferences have changed over the years. I will share the benefit of conference attendance: collaboration, comradery, and friendship which supports raptor conservation and our Foundation.

Demography and Ecoimmunology of Recruitment in Swainson's Hawks (Buteo swainsoni)

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The quality of perinatal conditions can impact nestling development and multiple life-history traits. Utilizing a long-term dataset of territorial occupancy for Swainson's Hawks in Butte Valley, California, we examined the effect perinatal conditions had on physiological and immunological condition. In conjunction with routine banding and population monitoring, blood samples were collected from nestlings prior to fledging. We utilized two immunological assays, a bactericidal and hemolytic-complement activity assay along with leukocyte differential counts (Heterophil:Lymphocyte ratio) to evaluate immunocompetence. Several metrics were used to determine if immunocompetence was related to perinatal conditions: body condition at banding (i.e., weight adjusted for size), age at banding, territory quality assessed

by occupancy rate of each territory over the last 25 years of monitoring, number of siblings, hatch order, hatch date, development score, and endoparasite prevalence. Preliminary work in 2013 showed a positive correlation between immunocompetence and territory quality and a negative correlation with number of siblings. Presently, we have expanded the study to include multiple years of sampling and additional perinatal metrics. Our study will explore the potential trade-offs between development of immune function and life-history traits as well as the efficacy of immunity assays to monitor population health.

Bald Eagle Lead Exposure in the Upper Midwest

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In 2012, 58 Bald Eagles (Haliaeetus leucocephalus) that were found dead along the Upper Mississippi River and in the adjacent states of Minnesota, Wisconsin, and Iowa were (1) examined for clinical signs of lead exposure, (2) measured for morphometric data, and (3) analyzed for lead in livers. Sixty percent of Bald Eagles had detectable lead concentrations and 37.9% had concentrations within the lethal range for lead poisoning. The results of the liver lead analysis prompted us to initiate a voluntary non-lead ammunition voucher program during the 2012 managed deer hunts at the Lost Mound Unit of the Upper Mississippi River National Wildlife and Fish Refuge (Refuge) in northwest Illinois. This was the first program in the National Wildlife Refuge System known to provide vouchers for free non-lead ammunition to reduce the threat of lead on the landscape and exposure to Bald Eagles. Of 31 white-tailed deer (Odocoileus virginianus) harvested during managed deer hunts on the Refuge, 32.3% were shot with non-lead ammunition provided by the voucher program, 25.8% were shot with non-lead ammunition provided by the hunter, and 41.9% were shot with lead ammunition. We collected and radiographed the offal from the deer shot with lead ammunition. The radiographs showed that 38.5% of the offal, which would have been discarded on the Refuge, contained lead fragments ranging from 1-107 particles per offal specimen. This indicates that lead is on the landscape and available to Bald Eagles. The use of non-lead ammunition for deer hunting is an effective management tool that reduces the amount of lead on the landscape, thus limiting exposure to Bald Eagles and other scavenging wildlife. Increasing hunter awareness through a broad information campaign on the relationship of lead ammunition to lead exposure in Bald Eagles is an important management tool for voluntary use of non-lead ammunition.

Raptor Research and Conservation in East Africa: 35 Years After Dr. Leslie Brown

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The late Dr. Leslie Brown, who passed on in 1980, first established raptor studies in East Africa. Since then, numbers and diversity of wildlife, especially raptors, have dramatically declined as a result of human-caused habitat changes, agricultural intensification, and the indiscriminate use of poisons such as carbamates. Livestock overgrazing, forest fragmentation, and human population growth in and around national parks and game reserves have further exacerbated raptor population declines. The predicted growth in East Africa's energy sector from oil exploration, construction of additional power lines, and wind turbines will further increase the rate of raptor population declines. Efforts to mitigate the magnitude of these declines will need commitment from East African governments and the conservation communities to ensure the survival of species that are on the threshold of collapse. On the positive side, great strides have been achieved in East Africa in the field of raptor research, local capacity development, and outreach. With support from organizations such as The Peregrine Fund, these studies have significantly enhanced our knowledge about little known raptors, increased a cohort of young African raptor biologists and heightened public awareness about the need to conserve raptors and their habitats. This paper specifically highlights the scientific, educational and conservation achievements made in raptor biology and conservation in East Africa since the demise of Leslie Brown.

Human Dimensions: Raptor-Human Conflict in Urban Settings

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Traditionally, raptors such as Bald Eagles (Haliaeetus leucocephalus), Ospreys (Pandion haliaetus), and Barred Owls (Strix varia) were thought of as wilderness-inhabiting species. However, due to the amazing plasticity these birds exhibit in regard to their habitat use patterns, during recent years these species are commonly found in high abundance in suburban and urban settings. These changes in habitat use patterns result in considerable interactions

between humans and urban raptors. Although there are clearly positive aspects of these frequent human-raptor interactions (such as environmental education opportunities and increased contact with the natural world by urbanites), a diversity of raptor-human conflicts has also resulted from the presence and abundance of urban-dwelling raptors. This presentation will provide numerous examples of raptor-human conflicts that occur in urban ecosystems, including situations that involve human health and safety issues, economic impacts of varying degrees, and other problems. As human populations continue to grow and urbanization spreads across many landscapes, the frequency and complexity of these issues will only increase during the coming years. Lastly, management and mitigation options will be discussed that are focused on alleviating these raptor-human conflicts to minimize impacts and maximize benefits to both people and birds.

A Review of Over 30 Years of Band Encounters from HawkWatch Sites in Western North America

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In 2008, the 'State of North America's Birds of Prey' (SNABP) was published, summarizing the results of count and banding efforts made at migration monitoring sites across the continent. This publication included an examination of recapture/recovery locations of raptors banded during migration at North American watch sites through 2006. These recovery data were useful in delineating/confirming major North American migratory flyways. We examine banding data from HWI sites in western North America for the decade since SNABP and compare them to previous results while exploring additional insights from recent efforts. From the early 1980's through 2006 HWI crews captured and banded 80,234 raptors (21 species) across five fall and one spring migration site in Washington, Oregon, Wyoming, Nevada, and New Mexico at the Chelan Ridge, Bonney Butte, Commissary Ridge, Goshute Mountains, Manzano Mountains, and Sandia Mountains HWI migration sites respectively. Through 2006 there had been 490 band encounters (including recoveries and recaptures) of nine species (0.6% encounter rate). Since 2006, HWI has banded 23,059 additional raptors (21 species) and 286 individuals (seven species) have been encountered (1.2%). Of these encounters, 110 were banded before or in 2006 while the remaining 176 were banded after 2006. In total, raptors banded at HWI migration sites have been encountered in 18 states within the USA, four provinces and one territory within Canada, and 18 states within Mexico. Average encounter distance from the original banding site to the encounter location (n = 761) was 937 km (SD = 770). Encounter distances for American Kestrels (Falco sparverius) (n = 14) were the largest, averaging 1,767 km (23 km to 3,118 km). Cooper's Hawks (Accipiter cooperii) (n=303) were encountered most frequently and comprised 40% of all encounters. Our goal is to provide an informative perspective of band encounters for raptors migrating throughout the western flyways.

Project SNOWstorm: A Case History in Collaborative Raptor Science

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Project SNOWstorm, created in December 2013 in the wake of the largest irruption of Snowy Owls (Bubo scandiacus) in the Northeast and Upper Great Lakes in decades, has grown into a collaboration of more than 40 researchers, banders, wildlife veterinarians, and pathologists using a variety of techniques to explore the winter ecology of this raptor. Funding has come entirely from the public, primarily through online crowd-funding and organizational donations, and public engagement has been a high priority and powerful tool. From 2013-2016, 43 Snowy Owls in 10 states were tagged with GPS/GSM transmitters, providing by far the most detailed dataset on winter, migratory, and non-breeding summer movements by this species. Thousands of geo-tagged photographs of owls with spread wings and tails, submitted by the public, permitted the mapping of broad geographic patterns in age/sex class distribution. Intensive necropsies and laboratory testing for contaminants, disease, and parasites have been conducted on >150 salvaged owls, and isotopic and genetic analyses are being conducted on samples from banded and salvaged individuals.

Summer Movement Patterns of Non-Breeding Snowy Owls (Bubo scandiacus)

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Little is known about summer movements of non-breeding Snowy Owls. Six individuals tagged with GPS/GSM transmitters between 2013-2016, and 20 tagged with PTTs between 1999-2016, provide a unique dataset of summer movements in the Canadian Arctic and subarctic. Owls summered as far north as Baffin Island and the Boothia Peninsula, NU, and as far south as Cape Henrietta Maria, MB. GPS/GSM transmitters provided unusually detailed (30-min. duty cycle) information on summer movements. Activity areas differed dramatically in size. One adult male traveled ~2400 km in an area of ~3800 km2, while a second-year male traveled ~1200 km in an area of more than 4000 km2. In contrast, a second-year female used just 0.8 sq. km from 2 June to 29 July (when her transmitter failed), except for a two-day, 25.5-km excursion. None of the GPS-tagged owls, including a known-age male in his third calendar year, showed highly localized movement patterns indicative of breeding, supporting assumptions that male Snowy Owls do not breed until at least 3-4 years of age.

Intraspecific Variation in Movement Strategies Among Bald Eagles (Haliaeetus leucocephalus) in an Anadromous Fish System

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While much empirical evidence exists regarding variability of movement strategies among different species, evidence is less prevalent for the extent of variability of movement strategies within species. Intraspecific variation in movement strategies may be particularly prevalent in environments in which resources are highly variable, as individuals that can learn when and where to access the best resources and alter their movement strategies accordingly will be those most likely to survive and reproduce. Here, we explore intraspecific variation in movement strategies of a species in a large-scale, heterogeneous environment, using Bald Eagles in the highly variable anadromous fish system of the north Pacific coast as a case study. We tracked 30 Bald Eagles (five immature, 25 adult) using GPS transmitters between May 2010 and January 2016. We found evidence of four distinct movement strategies among Bald Eagles in southeastern Alaska and western Canada: sedentary breeders who remained on nesting territories year-round, localized individuals who made predominately short-distance movements among sites, migratory individuals who consistently traveled between distinct summer areas and winter ranges, and nomadic individuals with irregular movement patterns that showed little interannual consistency in terms of departure dates, travel pathways, or sites visited. On average, male eagles traveled more per day than females ($p < 0.001$) and immature eagles traveled farther per day than mature eagles ($p < 0.0001$). The highly variable anadromous fish system of the north Pacific coast likely contributes to behavioral plasticity in Bald Eagles in this region and results in a range of movement strategies in the population. Effective conservation and management of north Pacific Bald Eagles will require a framework that recognizes the high variability in movement strategies adopted by individuals in the population.

Molecular Analysis of the Population Structure of the American Kestrel (Falco sparverius) across the North American Continent

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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 number of the species found in North America through counts at nest box programs, banding sites, and hawk watches. Recent count reductions have been greatest in the eastern and northern areas of the continent, but our understanding of how these declines may be affecting the species as a whole is hampered by limited understanding of the population structure of the species, and how different breeding areas may be connected to each other. Previous genetic studies have examined changes in population size in specific areas of interest, but no study has yet examined the genetic diversity and structure of the species across the American Kestrel's full continental range. In this study we used microsatellite data collected from breeding localities of the two different subspecies (F. s. sparverius and F. s. paulus) across the entire geographic extent of the species in North America (n = 375). Genetic data was used to

construct a geographic map of the population structure of the American Kestrel, which was then compared to genetic samples collected from kestrels on migration along several North American migratory flyways. Results from this analysis indicate that the population structure of American Kestrels in North America is more interconnected than has been previously hypothesized.

Kate Davis, Bald Eagles

Speed Talks

Blood Lead Levels of Golden Eagles (Aquila chrysaetos) Captured in Alaska, Implications and Possible Sources.

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Heavy metal contaminants in raptors, especially high lead exposure, has been a growing concern for the past 30 yrs. As such, there has been nationwide investment in describing lead levels in raptors and evaluating potential sources of lead exposure. We investigated blood lead levels of 66 free-ranging Golden Eagles captured as spring migrants (n = 36 adults and 8 sub adults) at Gunsight Mountain, Alaska, or banded as nestlings (n = 22) on the Seward Peninsula, Alaska. We also analyzed lead isotopes (206Pb:207Pb ratio) in these samples to evaluate potential sources of lead in migrants. Adult birds had the highest lead concentrations (mean = 0.0955 PPM, Max = 0.93, Min = 0), followed by sub adults (mean = 0.0448 PPM, Max = 0.3136, Min = 0), and lastly nestlings (mean = 0.0043 PPM, Max = 0.054, Min = 0). Lead isotope ratios in migrating eagles were closer to that of published values for rifle ammunition than for any other published source. Our preliminary results demonstrate how life stages and geographic region may interact to influence lead exposure of eagles. Comparison of these results, especially the eagle chicks, with those from areas where shooting is more common may provide additional insight into sources of lead contamination in eagles.

Identifying Behaviors of Eagles using Activity Thresholds

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Recent advances in telemetry have made it possible to collect a continuous record of activity. We deployed CTT Telemetry units equipped with an activity rate feature (Cellular Tracking Technologies) on 10 Bald Eagles (Halieeatus leucocephalus) and Golden Eagles (Aquila chrysaetos). The CTT's on-board accelerometers recorded continuous sets of data at 100 HZ (one hundred points per sec). We compared these data to an acceleration threshold that we specified. Above that threshold we categorized the data as activity events. These activity events were expressed as rates by separating them into discrete time intervals, where smaller intervals corresponded to increased activity. Each activity event received a time stamp. We will present preliminary data on how we used our activity threshold and activity event data to measure mortality, seasonal and circadian rhythms, and behavioral events, i.e., foraging, flight (including powered flight versus soaring/gliding). Based on these behavioral data, we will show time budgets for each species.

Paying the Pipers: Mitigating the Impact of Anticoagulant Rodenticides on Predators and Scavengers

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Anticoagulant rodenticides, mainly second generation forms or 'SGARs', dominate the global market for rodent control. Introduced in the 1970s to counter genetic resistance in rodent populations to first generation compounds such as warfarin, SGARs are extremely toxic and highly effective killers. However, their tendency to persist and accumulate in the body has led to widespread contamination of terrestrial predators and scavengers. Commercial chemicals which are classified by regulators as persistent, bio-accumulative and toxic or 'PBT' chemicals and which are widely used with potential environmental release, e.g. DDT or PCBs, have been removed from commerce. Yet, despite consistently failing ecological risk assessments, SGARs remain in use because of demand for effective rodent control options and lack of safe and humane alternatives. Although new risk mitigation measures for rodenticides are now in effect in some countries, contamination and poisoning of non-target wildlife is expected to continue. Here we suggest options to further attenuate this problem.

Gray Hawk (Buteo plagiatus) Fledged Five Juveniles in South Texas

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We report, for the first time, a clutch of five that successfully fledged from a nest of Gray Hawks in south Texas. The Gray Hawk is a Neotropical raptor that breeds from Costa Rica north to southern Arizona, New Mexico, and Texas. Clutch size varies, with a maximum of four eggs reported. Thus, it was of great interest when we learned of a Gray Hawk nest in Bentsen Rio Grande State Park that had five nestlings (Lat. 26o 10' N, Long. 98o 23'W). The nest was

reported to eBird by Cèdric Duhalde on 5 June 2015. MG and RR verified that there were indeed five nestlings shortly thereafter. All five chicks successfully fledged and were seen in the park together, often with a pair of adults, for up to six months after fledging.

Identification of Small Mammals and Prey Density During Northern Saw-Whet Owl (Aegolius acadicus) Migration at Rushton Woods Preserve, Pennsylvania

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Banding records of the Northern Saw-Whet Owl (NSWO) collected between 2012 and 2015 from the Rushton Woods Banding Station located in southeastern Pennsylvania, were analyzed in combination with small mammal activity to understand how NSWOs respond to prey availability across four different habitats during fall migration. A large number of NSWOs were banded at Rushton Woods Preserve in 2012, during an irruptive year. According to banding records this is known to occur once every three to five years. Comparisons between NSWOs captured and small mammal activity reveal that NSWO capture rates do not correlate to prey activity within the Rushton Woods Preserve. Although more study is needed, this project could be replicated at other Project Owlnet banding stations as a tool for answering ecological questions regarding NSWO fall migration and prey availability.

Gone to Ground: Dynamics of Foraging-associated Risk of California Condors (Gymnogyps californianus) in the Human-dominated Landscape of Southern California

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The success of wildlife conservation is often dependent on mitigation of risk to species well after recovery and reintroduction. Despite a remarkable recovery over the past thirty years, California Condors (Gymnogyps californianus) continue to face substantial risk in the human-dominated landscape of southern California. These risks include threats while flying (e.g., wind turbines), but also those close to the ground such as lead poisoning from the ingestion of spent ammunition, micro trash ingestion, collisions with human structures, and environmental contamination. The spatial and temporal conditions under which condors might encounter risk on or near the ground are not well understood. We investigated the characteristics of sites where condors are on the ground to identify behavioral patterns that might aid in conservation of this critically endangered species. We tracked 27 birds with GPS telemetry over the course of more than twenty months. Preliminary analysis suggests that condor visitations to ground sites were concentrated during the middle of the day with the majority of ground foraging occurring over a four-hour period from 1030 to 1430. Rates of visitation to and the landscape characteristics of foraging sites varied from month to month and both were positively associated with relatively higher ground elevations and higher surface roughness in Woodland Savanna habitats. Our study is the first to examine foraging site dynamics on a fine spatial and temporal scale for this critically endangered species and offer valuable insight into conversation and management strategies of condors.

Western Burrowing Owls (Athene cunicularia): Conservation Challenges Associated with Urban Living in Western Arizona

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Burrowing owls are labeled as species of conservation concern across the western United States. In Lake Havasu City, Arizona, owls are commonly observed in nontraditional habitats; desert washes (arroyos) in developed locations. Urban and suburban washes may offer a large prey base and abundant existing burrows, but Burrowing Owls are susceptible to disturbance from humans, predation by high densities of coyotes, and exposure to poisoned prey. We began studying habitat preferences and productivity of local Burrowing Owls in February 2014. Over the past three breeding seasons, we documented burrow and habitat characteristics and monitored 61 nests. Nest success increased from 2014 to 2015 (44% to 75%) and the mean number of fledglings to date is 3.5, but preliminary results for 2016 suggest a decline in productivity. Since 2014, 14 nests were found abandoned for unknown reasons, and 16 experienced a mortality of one or more adults and chicks. Four fresh carcasses found in 2014 were confirmed to be contaminated with high levels of brodifacoum, the compound

commonly used in second generation anticoagulant rodenticides. High levels of mortality throughout that year may be responsible for the difficulty we experienced in locating nesting pairs this year. No significant differences were found when comparing plant cover, prey availability, number of satellite burrows, or height from wash floor at successful vs. failed nest sites (Mann-Whitney tests). However successful nests had larger average diameters. Results of Poisson regression models suggest that nest sites experiencing a mortality were less likely to produce fledglings. To date, there have been no similar studies of natural nest sites in urban/suburban locations of the southwest. Our research over the next three nesting seasons will continue to provide baseline data on the local population as well as help biologists and managers understand the owls' unique habitat preferences.

Winter Nesting of White-tailed Kites in South Texas

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The Birds of North America account for White-tailed Kites (Elanus leucurus) reports young in the nest from mid-March into October. According to previous work by Oberholser, they breed in Texas from March to September, with egg dates from March 18 to August 21. We report on the first record of winter nesting for the White-tailed Kite for North America in January 2015 in the lower Rio Grande Valley of south Texas, where they are fairly common breeding residents.

Efficacy of Invertebrates as an Alternative to Vertebrate Lure Animals for Trapping Raptors

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Field studies of raptors often involve the use of live vertebrate prey to lure birds to snares in order to collect tissue samples, affix telemetry equipment or attach bands. In the United States all research, testing or teaching that involves vertebrates must be reviewed by the Institutional Animal Care and Use Committee (IACUC) of the host institution. These standards apply not only to the birds being studied, but also to the vertebrate lure animals used for trapping them. This can produce challenging requirements for housing the small numbers of lure animals typically required for raptor research. Although IACUC approval is mandatory for research involving vertebrate animals, it is not required for the use of invertebrates. This project explores the use of invertebrates as an alternative to vertebrate lure animals. In Washington and Yamhill Counties, we collected data on the behavioral response of American Kestrels (Falco sparverius) to two different lure animal choices: House Mice (Mus musculus) and Madagascar Hissing Cockroaches (Gromphadorhina portentosa). Observational data were collected on wild American Kestrels presented with modified bal-chatri traps placed near birds perched along roadsides. American Kestrels were found to approach traps containing mice more often and spend more time investigating them compared to traps containing cockroaches. Although the results showed higher levels of response to mice, American Kestrels did show interest and approached invertebrate lure animals. This research provides raptor biologists with a direct comparison of the use of invertebrates and vertebrates as lure animals. Knowledge of the effectiveness of different lures in capturing birds of prey can guide the design of field studies that effectively answer research questions while minimizing the impact on wildlife as well as the animals used to attract them.

Historic and Emerging Sources of Mortality in Bald Eagles in Michigan, 1987-2011

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Necropsies on dead birds or diagnostic evaluations on the occasional grounded individual were performed on 1,001 Bald Eagles (Haliaeetus leucocephalus) recovered within the state of Michigan, USA from 1987 to 2011 to determine the primary cause of death or grounding (COD). Recovered dead or grounded eagles increased proportionally with the increasing number of occupied breeding areas throughout the study period. Trauma and poisoning were the greatest primary CODs. Within trauma and poisoning, vehicular trauma (n = 268) and lead poisoning (n = 99) caused the greatest number of recovered dead or grounded Bald Eagles. The trend in number of eagles recovered due to lead poisoning also increased within the most recent five years in comparison to the constant growing trend of occupied breeding areas, suggesting density dependent effects related to increased wintering or breeding populations.

Clostridium botulinum type E and barbiturate poisoning are also increasing as an emerging causes of mortality. We recommend moving road-killed carcasses, especially white-tailed deer (Odocoileus virginianus), from the main thoroughfare to the back of the right-of-way, and the transition from lead ammunition to non-toxic alternatives to decrease these main anthropogenic sources of mortality for Bald Eagles and a multitude of scavenger species.

Marcel Gahbauer, Red-tailed Hawk

Poster Abstracts

Secondary Anticoagulant Rodenticide Exposure of Red-tailed Hawks (Buteo jamaicensis) Migrating Through the Marin Headlands, California

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Secondary exposure to anticoagulant rodenticides (AR's) has been documented in many non-target species, particularly raptors, across the United States. The Red-tailed Hawk, as a raptor that frequents agricultural areas and whose diet consists mainly of rodents, is especially susceptible to poisoning. The aim of this study was to determine the extent to which Red-tailed Hawks are exposed to AR's. We collected blood from 100 Red-tailed Hawks migrating through the Marin Headlands just north of San Francisco, from August to December 2015, and tested these samples for AR's. We found 8% of birds sampled tested positive for some amount of AR. AR's detected included diphacinone, brodifacoum, bromadiolone, and chlorophacinone. These findings suggest that Red-tailed Hawks are being exposed to anticoagulant rodenticides somewhere along their migration route. To further determine the rate of poisoning in raptors, additional studies should be conducted closer to areas of AR application, such as agricultural fields and urban areas.

Auditory Frequency Sensitivity of Northern Saw-whet Owls (Aegolius acadicus)

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Northern Saw-whet Owls are known for their ability to hunt successfully at night, using only sound cues to localize their prey. However, little is known about the auditory capabilities that underlie their nocturnal hunting. In this study we used auditory evoked potentials (AEP) to assess Northern Saw-whet Owls' frequency sensitivity and response to clicks presented at varying rates and amplitudes. We found that Northern Saw-whet Owls responded most strongly to frequencies between 3 kHz and 6 kHz. We found no effect of presentation rate of clicks, but found a decrease in response amplitude with decreased stimulus amplitude. The shape of the Northern Saw-whet Owls' audiogram was similar to that of the Eastern Screech Owl (Megascops asio), the only other owl species for which AEP estimates of auditory sensitivity are available. However, the estimates for Northern Saw-whet Owls were generally 10-20 dB more sensitive than those reported for Eastern Screech Owls. Future research should focus on auditory specialization for sound localization, given its importance for prey localization.

Estimating Bald Eagle Population Size in the United States with Monitoring Data: the Post-Delisting Survey, Population Estimates, and Planning for Future Surveys.

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In 2009, with assistance from many States, Tribes, and other collaborators, the U.S. Fish and Wildlife Service conducted a national-scale survey to estimate the total number of occupied Bald Eagle (Haliaeetus leucocephalus) nesting territories in the coterminous U.S. The survey followed a dual-frame sampling design modified to account for detectability of nest structures, and tested with pilot studies in several states from 2004–2006. We estimated 16,048 (SE 727) occupied Bald Eagle nesting territories in the coterminous U.S. in 2009. We then used a stage-structured population model to estimate population size using the estimated number of occupied breeding territories (representing the number of breeding pairs), and updated values for survival and productivity. That population size estimate combined with a previous estimate of population size for Alaska was 143,000 (20^{-} h quantile = 126,000) Bald Eagles for the entire U.S. in 2009. We attribute the increase from previous estimates to improved survey and estimation efforts, and to increases in Bald Eagle numbers. Consistent with the population model, independent Breeding Bird Survey (BBS) indices indicated Bald Eagles continue to increase over much of the U.S. The dual-frame approach illustrates the difficulties of adequately estimating the true number of nests from existing nest lists, and the challenges of effectively sampling across a large geographic extent. In the future it may prove effective to pair data from long-term, standardized surveys, such as the BBS, with targeted breeding or winter surveys aimed at refining population model parameters to provide population estimates.

Burrowing Owls, Common Ravens, and Power Transmission Lines in the Morley Nelson Snake River Birds of Prey National Conservation Area, Idaho

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Common Ravens (Corvus corax; hereafter ravens), generalist predators capable of behavioral innovation, present a threat to many species of conservation concern. Increases in raven abundance in some western landscapes have been associated with anthropogenic change. For example, energy infrastructure, including power transmission line towers, provide perching and nesting sites for ravens in areas often devoid of natural substrates. Some Idaho raven populations have experienced 11-fold increases, whereas statewide populations have increased five-fold since the 1960s. Belthoff and colleagues working in Idaho noted that ravens visited more than 60% of Burrowing Owl (Athene cunicularia) nests monitored with trail cameras. These ravens regularly kleptoparasitized Burrowing Owl nests, and at times preyed on nestlings. Burrowing Owls are of conservation concern in numerous western states, so understanding relationships between increasing raven populations and their potential effects on declining Burrowing Owl populations is essential. Thus, we examined the patterns of co-occurrence of ravens and Burrowing Owls in the Morley Nelson Snake River Birds of Prey National Conservation Area in Idaho through a series of surveys for each species, and through monitoring Burrowing Owl nests for raven predation. We did so in areas with and without power transmission lines and in areas proposed for new energy infrastructure development. We describe factors most associated with interactions between ravens and Burrowing Owls. These factors will be useful for pre- and post-construction comparisons of relationships between ravens and Burrowing Owls in areas scheduled for energy infrastructure development.

What is More Costly? The Effect of Migration and Resident Wintering Strategies on Telomeres of American Kestrels (Falco sparverius)

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Migration is a viable option for birds when abundant resources at their destination balance the energetic cost of flying a long distance. Birds can also choose to overwinter in their breeding grounds to avoid the cost of long-distance flight, and to have the first pick of territory and mates before migratory birds arrive. However, survival for overwintering birds is contingent on whether birds can secure enough resources to survive the winter. Telomeres are conserved non-coding repetitive sequences found at the end of Eukaryotic chromosomes that prevent chromosomal degradation. Several factors cause telomeres to shorten gradually, including age, environmental stressors, and life strategies (e.g., migration or resident behavior). Importantly, telomere length also predicts longevity in that individual birds with longer telomeres live longer, in general. Telomere lengths are therefore an excellent single metric to detect trade-offs between short-term success and long-term fitness. American Kestrels in southwestern Idaho both overwinter and migrate. We captured adult American Kestrels during the breeding season, marked each bird with a band, and collected a small claw sample and a blood sample. Claw samples were washed, weighed, and hydrogen stable isotopes ratios were estimated using a mass spectrometer. We used hydrogen stable isotope ratios to determine wintering strategy. DNA was extracted from blood samples using commercially available kits. Telomere lengths were estimated by quantitative PCR (qPCR) using primers that bind to the telomeric repeat. This qPCR signal was normalized to the PCR signal from a single copy gene. Understanding the trade-offs between the costs of migration and overwintering is important for predicting how Kestrels will alter their wintering strategies in response to climate change.

Western Burrowing Owls (Athene cunicularia hypugaea) Fleas during a Ground Squirrel Plague Epizootic in Idaho

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Western Burrowing Owls are small, ground-dwelling owls of western North American grasslands and steppes. As the owls rely on rodent prey and occupy burrows once or concurrently inhabited by fossorial mammals, they often harbor fleas. One predominant species of flea infesting Burrowing Owls is Pulex irritans (Family Pulicidae), the so-called human flea. Fleas are noteworthy because they act as vectors of Yersinia pestis, the etiological agent of plague. It remains poorly understood what role P. irritans and other Burrowing Owls fleas may have in plague dynamics. In 2015, a plague epizootic occurred in southern Idaho, resulting in die-offs of Paiute Ground Squirrels (Urocitellus mollis). There was high potential for Burrowing Owls to encounter infected fleas or squirrels because the owls nest in proximity to Ground Squirrels, may use some of the same burrows, and prey on the squirrels at times. Indeed, dead squirrels sometimes occurred within owl nest territories. We took this opportunity to examine flea species diversity and intensity of flea infestation on owls during and after the plague epizootic, and tested fleas collected from owls for Y. pestis using PCR. We also evaluated if fleas more common on Ground Squirrels switched to Burrowing Owls as alternative hosts as the Ground Squirrels succumbed to plague. Finally, to determine patterns of change, we compared these relationships from the 2015 plague outbreak to those the year after. Our study helps further the understanding of the biology of Burrowing Owls, and the ecology of plague in western landscapes.

Post-fledging Behavior of the Western Screech-Owl (Megascops kennicottii) in Idaho

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Although locally common in western North America, the ecology of Western Screech-Owls remains relatively poorly studied. One reason is that they are nocturnal, which makes direct observations difficult. Western Screech-Owls are also cryptic in appearance and somewhat secretive in habit. For many birds, the post-fledging period is also poorly understood because newly fledged young move from the vicinity of their nests, and track of them is quickly lost. For birds of prey such as owls, the post-fledging period is generally more protracted than for other species of birds. As young owls must develop not only flight skills, they must become proficient at capturing prey before dispersing from natal areas. Thus, the post-fledging period in owls can last for months. Our objective was to examine the post-fledging behavior of Western Screech-Owls. We studied Western Screech-Owls in the Morley Nelson Snake River Birds of Prey National Conservation Area in southern Idaho, and used radio-telemetry to help observe them. We radio-tagged nestlings shortly before they fledged, and captured and radio-tagged adult care-givers at each nest so that we could monitor entire families throughout the post-fledging period. By locating radio-tagged owls each day, we quantified movements of owls after fledging, their roosting behavior in relation to the nest, proximity of family members, habitat use, and the timing of brood break-up and dispersal. We evaluated hypotheses about the potential roles of available habitat, proximity to anthropogenic influences, and natural features of the landscape on owl post-fledging behavior. Our study helps further the understanding of the post-fledging ecology of raptors and the behavior of Western Screech-Owls.

Falcon Song: Size Matters

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The ability of birds to learn and produce complex songs depends on brain structure, neural connections, and on a complex syrinx. Two of the three clades that contain vocal learners, the Psittaciforms and Passeriforms, are sister taxa. Current systematics proposes that the Falconidae, which includes species of falcons and caracaras, are related to this cluster. Presumably falcons are not vocal learners, do not have syringeal modifications analogous to oscines, and do not have the necessary neural connections. Therefore, for these birds, song should not be a selective factor in their evolution, and variation in song structure should be relatively minor. We examined sound and syringeal structure in six falcon species and hypothesized that if these species were not vocal learners, then syringeal size would be the major factor in song variation.

Understanding Drivers of Variation in Reproductive Success of Migratory Golden Eagles (Aquila chrysaetos)

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Variation in fecundity underpins aspects of demography and evolution, and can be driven by a suite of factors, including variation in individual and habitat quality, and environmental fluctuation. However, because of logistical constraints, many studies of fecundity variation have been restricted to local scales. Here, we evaluated the potential relationship between annual environmental variation and reproductive output of Golden Eagles at a semi-continental scale. We used motion-sensitive trail cameras set at scavenging bait sites over multiple years to collect images of Golden Eagles wintering across large geographic extents in the Appalachians. These photographs allowed us to estimate annual ratios of hatch-year to adult, and to all eagles. Using regression approaches we examined relationships between estimated age ratios and environmental parameters measured on Canadian summer breeding grounds to help elucidate drivers of fecundity for Golden Eagles in this portion of their range. This work demonstrates the utility of remote trigger trail cameras to studies of avian ecology, and the linkages between large-scale patterns in demography and environmental fluctuations.

Assessment of Raptor Migration Corridors in Arizona's Sky Islands

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During the fall and spring raptors are known to use leading lines to help guide their migration to and from wintering and breeding grounds. Mountain ranges are often leading lines because they create updrafts and thermals, and rivers provide visual pathways. The mountain ranges and rivers in central and southeastern Arizona are part of a known flyway for migrating raptors. However, the potential concentration of raptors along leading lines in this region could present conflicts with the placement of wind turbines. Our objective was to assess the use of mountains and rivers in central and southeastern Arizona by migrating raptors. We counted migrating raptors in the spring and fall for two years at ten paired count stations (eight pairs of stations were in mountains with one station of each pair located as high as possible given road access and the other in the valley; two paired stations were along rivers with one station located on the river and the other away from the river). Counts at each pair were conducted simultaneously and began 2 hr after sunrise and continued for 5 consecutive hrs. During 577.5 observation hrs, 1,139 raptors were counted (2.0 raptors/hr). Counts of raptors at high mountain stations and river stations were slightly higher (2.4 raptors/hr) than counts at low stations and off river stations (1.6 raptors/hr). The numbers of migrating raptors we counted are low relative to counts of raptors during migration in other sites in the West, which range from 3.9 to 77.3 raptors/hr. Our data suggest the mountain ranges and rivers in central and southeastern Arizona are not a major migration pathway for raptors.

If You Build It, They Will Come: Evaluating the Role of Man-Made Nest Platforms and Anthropogenic Landscape Change on Shaping the Habitat Suitability and Breeding Success of Ospreys (Pandion haliaetus) in West-Central Idaho

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Osprey are fish-eating, top predators of aquatic ecosystems that serve as useful sentinel species for monitoring environmental contaminants and ecosystem health. Since declines within the continental U.S.A. from 1950-1970, the majority of populations have recovered, yet breeding densities in many areas are variable, with several areas unoccupied despite the apparent existence of quality habitat. Ospreys further appear highly adaptable to human-dominated landscapes and readily nest on man-made substrates that occur within an array of land use and cover (LULC) types and human settlement regimes. In Long Valley Idaho, the abundance of breeding Ospreys has declined slightly since the late 1970's while the distribution of nests and nest substrate use has changed dramatically. From 1978-1980, 86% of the 127 occupied Osprey nests were located in trees. By 2014, only 16% of 102 occupied nests were located in trees while 84% were located on man-made structures (predominately nesting platforms on power infrastructure, and free-standing poles). To evaluate if changes in nest substrate use, coupled with increasing anthropogenic landscape conversion could be creating ecological traps within Osprey breeding habitat, we evaluated relationships among nest site characteristics and Osprey nesting success over two breeding seasons. We used multivariate generalized linear models with model selection procedures to evaluate the relative importance of LULC composition and nest site characteristics associated

with anthropogenic disturbance on Osprey nesting success. Here, we present the results of our model from two breeding seasons and discuss their applications for Osprey conservation and management.

Winter Habitat Association of Migratory Pre-Adult Golden Eagles from Interior Alaska

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Golden Eagles (Aquila chrysaetos) that breed at high latitudes also migrate long distances between their summer and winter ranges. Conditions on winter range are known to have carryover effects on health and survival of breeding-season individuals and ultimately on populations. To understand behavior of eagles during winter we used Kernel Density Estimates (KDE) to define space use of telemetered first-year Golden Eagles hatched in Denali National Park and Preserve, Alaska (Denali) and then we defined habitat associations of these wintering eagles. Telemetry data were collected from 20 individual nestling eagles tagged in Denali in 1997 and 1999 and tracked for up to 2 yrs. We fit separate preliminary linear models for land cover and for topographic variables for each individual home range (hr95). The model that best explained the land cover included coniferous forest, broadleaf forest, shrub, grass, and crop lands variables (AIC 50.172). The model that best explained topographic variables within the home range included topographic roughness, topographic position canyon, and topographic position steep slope (AIC 51.601). The results of this study can inform managers on habitat use by juvenile Golden Eagles, and aid in management at state, federal and international scales.

Flushing Responses of Golden Eagles (Aquila chrysaetos) to Outdoor Recreation

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Recreation disturbance can affect raptor behavior and potentially reduce breeding success; understanding the spatial and temporal factors contributing to these is an important management priority. Our objective was to determine if the type of recreationist, nest attendance, or date affected flushing behavior and distances of adult Golden Eagles during the breeding season. During 2013 and 2014, we monitored eagles in 23 nesting territories in the Owyhee Front of southwestern Idaho. We observed eagles at nests and nearby perches and recorded recreational activity within 1200 m of eagles and eagle responses. In most (86%, n = 270) encounters, eagles did not flush in response to recreationists passing within 1200 m. Eagles were 60 times more likely to flush in response to motorized recreationists that stopped and transitioned to walking, and 4.5 times more likely to flush in response to off-highway vehicles (OHVs) than during encounters with road vehicles. Flushing was 12 times more likely for eagles away from nests than eagles at nests. Additionally, eagles flushed at greater distances in response to motorized recreationists that transitioned to walking (lsmean = 620 m) than when responding to either OHVs (lsmean = 525 m) or road vehicles (lsmean = 318 m). Flushing distances declined throughout the breeding season, suggesting seasonal changes in the costs and benefits of responding to disturbance. After flushing from nests, most eagles (77%) spent < 40 min away from nests, but some (23%) spent > 90 min away. Limiting recreational activities within 650 m and 1000 m of nests may decrease nest-site flushing events by 77% and 100%, respectively. Because eagles seem most sensitive to transitional recreation behavior, land managers may strike a balance between access needs of recreationists, and buffering eagles from disturbance by using both trail closures and no-stopping zones that prevent transitions from motorized to walking.

Juvenile Pallas's Fish Eagle Migration in Asia

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The Pallas's Fish Eagle (Haliaeetus leucoryphus) is a globally vulnerable species with a decreasing population trend. The species' historical range extended from the Caspian Sea to China, and from Russia to the Indian Subcontinent. However, seasonal movements and migration patterns are complex and severely data deficient. Conflicting observations suggest the potential for three separate breeding migrant populations located in Mongolia, China, and India, whose ranges overlap

around the Himalayas with inverse breeding seasons based upon climatic factors, such as the timing of spring thaw and the onset of the East Indian monsoon. During the summer of 2013, a 70g GSM-GPS transmitter backpack was attached to a juvenile Pallas's Fish Eagle at Ogii Nuur, Mongolia. In February 2014, an additional two 70g GSM-GPS transmitters were deployed on first year juvenile Pallas's Fish Eagles in Kaziranga National Park, Assam, India. Over the duration of 2013-2015, we were able to accumulate four full fall migration datasets from all tagged individuals. From 2014-2016, we collected an additional four spring migration datasets. All migration data was analyzed to determine connectivity, phenology, and site fidelity between the northern and southern tagged individuals. We also assessed the potential impact of weather upon the initiation of migration, such as the onset of the monsoon. Results indicate a potential connectivity between the sampled populations in Mongolia and India. In addition, there was a significant overlap in migration route and timing for all tagged individuals across multiple years. This study provides vital baseline data for future conservation efforts and gives groundbreaking insight into the migration ecology of this data-deficient and declining species.

Comparing Diet Analysis Methods for Osprey (Pandion haliaetus) in West Central Idaho

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Ospreys are top predators of aquatic ecosystems that exclusively prey on fish. Tolerant of human disturbance and adapted to human landscapes, Ospreys are often used as sentinel species for monitoring ecosystem health. Since Ospreys are fish specialists, fishery resource management can crucially influence Osprey reproductive viability. Diet analyses are thus an important aspect to understanding Osprey breeding biology and conservation needs. Osprey diets have classically been estimated using foraging observations and collecting prey remains from within and below nests. While these approaches are easy to implement and reproduce, they can be time intensive, and produce biased results that underestimate biomass and species assemblages due to small or inconspicuous individuals. We implemented and compared two different diet analysis methods for Osprey in west central Idaho. Our analysis tested the economics (i.e. cost, effort required to collect, identify, quantify, and compile data) and efficiency of prey remains collections against photographs of prey deliveries to the nest. Using multivariate analysis of variance (MANOVA) we tested for significant differences between the different methods. Here we present our results and discuss their applications for future research, conservation efforts and Osprey management.

Testing Perch Deterrents and Supplemental Perches Designed to Mitigate Raptor Electrocutions

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Avian electrocution is an ongoing globally important conservation concern. Electrocutions occur because most overhead power lines are constructed with bare wire, to reduce wire weight, which reduces the number of poles needed per line. This allows lower energy costs, but can place birds, particularly raptors, at risk of electrocution when perching on poles. Electrocution mitigation focuses primarily on covering energized wires and equipment. Sometimes, covering energized components is not feasible, so perch deterrents and supplemental perches are used to shift perching raptors away from high risk points. Because these methods have met with limited success in the field, we are working to identify their strengths and weaknesses. We have completed two year-long studies, and are currently conducting another, evaluating the effectiveness of perch deterrents and supplemental perches on mock power poles within a flight conditioning enclosure of a wildlife rehabilitation center. To test a spiked perch deterrent designed to prevent raptor perching between insulators, we evaluated perching by 16 raptors. As reported in Northwestern Naturalist in 2016, deterrents were perched upon significantly less than all other perch options, and were perched upon significantly less than expected given their proportional availability. To test a supplemental perch, we compared perching on cross arms with and without a supplemental perch. As reported in Colorado Birds in 2016, the 17 raptors we tested used the supplemental perch significantly more than all other perch options, and the supplemental perch was perched upon significantly more than expected given its proportional availability. These data demonstrate that, at least in a captive setting, raptors can be shifted from high-risk perching locations on a pole. Our ongoing study builds on the two completed projects by evaluating the effectiveness of a combined perch deterrent

and supplemental perch. Our presentation will summarize and illustrate methods and results of all three studies.

Do Golden Eagles Select Green Nest Material to Decrease Ectoparasite Infestation?

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Birds of prey are vulnerable to a broad range of nest ectoparasites that may feed on blood, tissue, or feather material. Ectoparasite infection may lead to anemia, myiasis, increased risk of bacterial or fungal infection, and in extreme cases, premature fledging by nestlings. Both primary and secondary infections from ectoparasites can have detrimental consequences for the host species. However, studies have revealed that the presence of green, aromatic plant materials in bird nests can reduce the abundance of ectoparasites. It has been proposed that bioactive phytochemicals contained in aromatic plants are directly responsible for deterring ectoparasites. Previous studies have shown that birds may select green nest material from their territories. In the Morley Nelson Snake River Birds of Prey National Conservation Area, nestling Golden Eagles (Aquila chrysaetos) are exposed to several types of ectoparasites including ticks, blowflys, and avian bed bugs. Our objectives were to test whether Golden Eagles select aromatic green plant material from the surrounding environment to line their nests. In 2016, we conducted vegetation surveys in Golden Eagle territories and analyzed the secondary metabolites of those plants in lab analyses. We visited Golden Eagle nests throughout the breeding season to identify plant material in eagle nests. We estimated the amount of plant material in each nest, collected samples of nest material for identification and chemical analysis, and compared the presence of aromatic green plants to ectoparasite abundance. Preliminary evidence suggests that adult Golden Eagles decorate nests with aromatic plants that may reduce the number of ectoparasites on nestlings. These results have important implications for understanding how habitat degradation may affect environmental factors that could limit eagle reproduction.

Size Matters to Merlins

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Body size strongly influences fitness such that larger individuals benefit in terms of both greater productivity and survivorship; for reverse sexually size dimorphic (RSD) species, this relationship may not be as obvious. We examined the selection pressures acting on body size in male and female Merlins (Falco columbarius) to assess whether larger or smaller individuals were favored on the basis of survival and breeding performance. For males and females, there were clear links between body size and survival, but the exact relationship varied by sex. Among males, individuals that survived each year class were larger than those that died and yearlings were on average smaller than older birds, but there were no measurable differences among adult males (age 2+). For females, larger individuals aged one and two were more likely to survive, but this size-based pattern was not apparent among older age classes. Size during early life predicted the eventual lifespan in male Merlins, but not as strongly as for females, and not for the largest individuals. Reproductive performance based on brood size was not associated with body size in either males or females, but there was a weak positive relationship between female body size and lifetime reproductive success. Selection appears to favor larger males and females but there is no indication that the population is evolving toward larger individuals, perhaps in part due to selection against the largest birds. Increased survival may allow larger and higher quality individuals to occupy higher quality territories as they age and thereby accrue greater lifetime reproductive success in the process.

Evaluation of Nest-Site Imprinting in Burrowing Owls

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In many species of wildlife preferences for a certain area or locality may depend on early experience. These may be cases of ecological imprinting where ontogeny of this behavior includes the existence of a sensitive period early in life during which time the characteristics of habitat are learned, followed by subsequent stability of the result gained by experience during that period. Suggestions that animals imprint on nest sites (i.e., nest-site imprinting) through experience gained during the natal period have been in the animal behavior literature. For instance, Hess suggested nest-site imprinting when Mallards (Anas platyrhynchos)

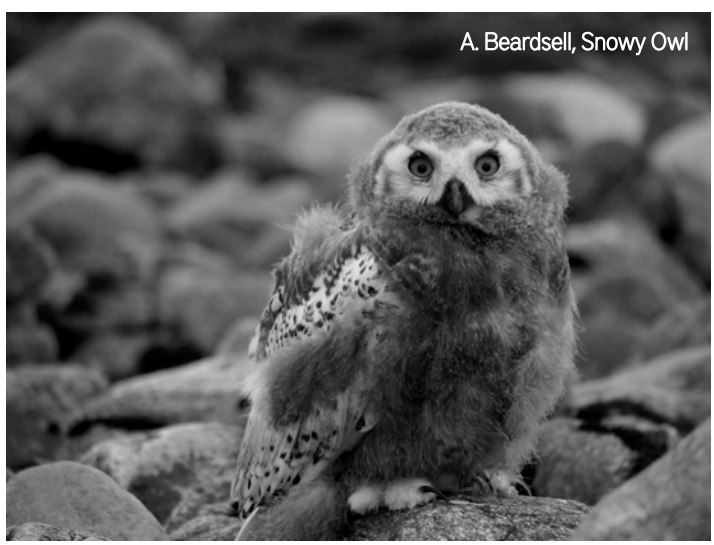
that hatched in incubators chose elevated nest boxes, whereas those hatched in natural nests preferred ground nests. Examples of possible nest-site imprinting in raptors include Peregrine Falcons (Falco peregrinus) selecting nest sites on buildings and bridges in North America after the release of captive-bred juveniles from artificial structures rather than cliff nest sites. Our objective was to investigate potential nest-site imprinting in Burrowing Owls (Athene cunicularia). We used long-term data collected between 1997-2016 for Burrowing Owls nesting in artificial burrows in the Morley Nelson Snake River Birds of Prey National Conservation Area in Idaho. These owls nested in artificial burrows that differed in chamber size and tunnel dimensions. Using observations of >250 individuals who were raised in artificial burrows and subsequently nested in them, we tested whether young raised in a particular burrow/tunnel configuration exhibited preference for that configuration throughout their nesting life, which would imply imprinting. Our results contribute to understanding of the ontogeny of behavior in raptors and the breeding ecology of Burrowing Owls.

Microhabitat Characteristics of Northern Goshawk (Accipiter gentilis) Nest Sites in the Naturally Fragmented Forests of the Northern Great Basin, U.S.A.

**LAUREN E. WHITENACK (lalauren@live.unc.edu), GREGORY S. KALTENECKER, JAY D. CARLISLE, and ROBERT A. MILLER, Intermountain Bird Observatory and Raptor Research Center, Department of Biological Sciences, Boise State University, Boise, ID, U.S.A.

The Northern Goshawk occupies a variety of habitats across its Holarctic range. The Goshawk has generally shown great flexibility in its use of habitat structure, but at the local level, a population may thrive under more specific conditions, rendering habitat models developed elsewhere less useful. We set forth to identify and quantify important characteristics of the habitat used by Goshawks within the high-elevation mixed forest and shrub-steppe landscape of the northern Great Basin in south-central Idaho. Our study area has a robust Northern Goshawk population, yet is structurally distinct from many areas where Goshawks have been thoroughly studied. Anecdotal evidence from the area suggests that Goshawks respond favorably to forest thinning, particularly within Lodgepole Pine stands; however, over-thinning may have resulted in territorial abandonment on more than one occasion. The available literature provides contradictory evidence with regards to the sensitivity of Goshawks to forest management practices, justifying increased analysis of the effects, particularly in areas with forest structure that deviates from previous study areas. We quantified micro- and macro-habitat characteristics associated with currently used, previously used, and unused Northern Goshawk territories within our study area to better inform local forest management practices, and to provide additional clarity to the established literature on Goshawk sensitivity to forest structural changes.


Jeff Zirpoli, Burrowing Owl


A. Beardsell, Snowy Owl

Speakers Index, General Session Abstracts

Speakers Index, Speed Talks

Jerry Liguori, Rough-legged Hawk

Speakers Index, Poster Abstracts

Jerry Liguori, Red-tailed Hawk

Jerry Liguori, Prairie Falcon

RRF Conference: Code of 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 can only be 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, 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.

RRF expects conference attendees to be able to engage in open discussions free of discrimination, harassment, and retaliation. We strongly believe that a community where people feel uncomfortable, threatened, or under discriminatory scrutiny is neither healthy nor productive. Accordingly, RRF strictly prohibits any degree of intimidating, threatening, or harassing conduct during our conferences, as well as in any other written or personal communication involving any activity of the Foundation. This policy applies to speakers, staff, volunteers, exhibitors, and attendees. Conference participants violating these rules may be sanctioned, expelled from the conference, or expelled from RRF at the discretion of the RRF Board of Directors.

Reporting an Incident

Any attendee who believes that he or she has been subjected to harassment, notices that someone else is being harassed, or has any other concerns about an individual's behavior should contact any member of the RRF Board. He or she will be not required or expected to discuss the concern with the alleged offender. All complaints will be treated extremely seriously and investigated during the conference itself, unless reported after its completion. Confidentiality will be honored to the extent permitted as long as the rights of others are not compromised. Maximum sensitivity to the discomfort of the harassed participant will be favored by assigning the lead of the complaint-management, whenever feasible, to a Board member as capable as possible to comprehend the sensitivity of the issue at stake, (e.g. cases of sexual harassment will be led by a Director of the same gender; cases of discrimination against a minority by a minority, foreign Director, or Director with experience working abroad etc.).

Disciplinary Action

Individuals engaging in behavior prohibited by this policy as well as those making false allegations of harassment 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, and the reporting of their behavior to their employer. Repeat offenders may be subject to further disciplinary action, such as being banned from participating in future meetings. Note that RRF has the right in its Bylaws to terminate the membership of any member. Disciplinary action will apply to all offenders participating in the conference, from non-RRF members to Board Directors.

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 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.

Anonymous reporting on our website: http://www.raptorresearchfoundation.org/contact/ A Board member will respond as quickly as possible.

Investigation Procedure

1. Whenever possible, the situation will be dealt with informally and in real time by approaching the offender and communicating a warning to the offender to immediately cease the behavior, without revealing the identity of the complainant and after approval about this procedure by the complainant.

2. Should this not be enough, and previous approval by the complainant, the RRF Board will name one or two impartial investigators, considered to be sensitive to the delicacy of the task and capable to assess it professionally.

3. Any named investigator who believes they have a conflict of interest should not serve as an investigator.

4. The investigator(s) will request an official written letter of complaint from the complainant (documenting the nature of the harassment and/or discrimination, with detailed information including times, places, nature of incident(s), and comments made). Supporting documentation (emails, notes, posts, etc.) and statements from witnesses should be submitted with the letter.

5. In most cases, the complainant will be interviewed first and the written complaint reviewed. If the complainant has not already filed a formal complaint, he or she should be asked to do so.

6. The details of the complaint should be explained to the alleged offender by the investigator.

7. The alleged offender should be given a reasonable chance to respond to the evidence of the complainant and to bring his or her own evidence.

8. If the facts are in dispute, further investigatory steps may include interviewing those named as witnesses.

9. If, for any reason, the investigator(s) is in doubt about whether or how to continue, he or she will seek appropriate counsel (from the RRF Board, legal–if approved by the RRF Board, etc).

10. When the investigation is complete, the investigator(s) will report the findings to the RRF Board. The Board will determine how to proceed and if a report should be submitted to the offender's employer.

Thank you for your understanding and profressionalism during the annual RRF conferences.

RRF Board: 50 Years of Thanks

Below is a list of past and present Officers and elected Board Members that have served the Raptor Research Foundation, Inc. (RRF) from 1966 through 2016. Our organization and membership stand on the shoulders of these "giants," who are responsible for the productive and influential society that we both benefit from and participate in today. With our immense respect, we give our appreciation for the unsung service of these individuals that made the RRF what it is today. Please take a few minutes to glance through this list of RRF Officers and Board Members and note the service contributions of any individuals that you know. If you see some of these individuals during the course of this conference, please let them know that you appreciated their great commitment and service to the RRF!

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Beatriz Arroyo (Director 1999 – 2004)
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Rob Bierregaard (Director 2012 – 2017)
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Trost Jolsen, Wedged-tailed Eagle

RRF: Celebrating 50 Years

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CELEBRATING THE 50TH ANNIVERSARY OF THE RAPTOR RESEARCH FOUNDATION

W. GRAINGER HUNT[1]
The Peregrine Fund, 5668 West Flying Hawk Lane, Boise, ID 83709 U.S.A.

Our organization, now 50 years in motion, began in the urgency attending the historic crash of Peregrine Falcon populations. When Joe Hickey called the world's experts to the University of Wisconsin in 1965 to seek the cause, the roles of DDT and dieldrin had yet to be examined. Events at that historic conference, however, included the presentation by Ian Prestt and Derek Ratcliffe showing a stunning geographical correspondence of cereal farming in Great Britain with declines among bird-eating raptors, a powerful demonstration implicating tiny, unseen molecules in the disruption of ecosystems. Minds might have raced to food-chain biomagnification, but such understanding, now familiar, was still far from mature. A day or so later, a small group of attendees met to discuss the real and present need for an organization focusing on the science and conservation of birds of prey. Five months passed, and in February 1966, Don Hunter, Byron Harrell, and Paul Springer signed the documents incorporating the Raptor Research Foundation. And here we are, thriving as is obvious, with robust attendance at annual meetings, a strong international breadth of membership, a scholarly journal with worldwide authorship, and all the advantages of instant, global communication.

Saving the peregrine remained the primary focus of RRF during its early years, with prolific exchanges of ideas and information permeating its meetings and the pages of *Raptor Research News*, the precursor of our *Journal of Raptor Research*. Surveys for remnant pairs, evidence of contamination, and refinement of the technology of captive breeding were at center stage through the early 1970s. A look back at those days would find our organization immersed in a diverse array of activity, all connected to what became a satisfying endpoint—from field biology to chemistry and physiology, from experimentation to population ecology and advocacy, and ultimately, to restoration.

While this first dragon was being slain, the much larger world of science was undergoing profound change. Biology was building upon the very recent elucidation of the DNA code and the details of protein synthesis, the nuts and bolts of evolution. The year 1966 brought two seminal books: David Lack's *Population Studies in Birds* and George Williams' *Adaptation and Natural Selection*. The first expounded upon the principle of density dependence, and the second placed the Darwinian concept on workable ground that bound together the sciences of evolution, ecology, behavior, and more. Soon we had John Maynard Smith's game-theoretical approach to life-history strategies. It was during this period that the first photographs of our planet were taken from space, and people began to more fully consider the biosphere as an integrated whole, an evolutionary masterpiece that could be damaged, and that some forms of damage could be severe, yet difficult to diagnose. I am of the opinion that the peregrine conference and the concurrent birth of the Raptor Research Foundation were working parts in this awakening.

The subject matter of RRF has thus diversified to its present pursuit of all forms of raptor-related science. While many projects explore the factual details, others expound upon them to find conceptual insights. And why are raptors so instructive? Perhaps it is because they tend to be long-lived, they are observable, conspicuous enough to be individualized with leg bands even at a distance, most hold readily definable territories, they leave prey remains as evidence of their diets, they are large enough to carry powerful, long-lasting radio transmitters that show

[1] Retired; email address: grainger@peregrinefund.org

their movements over a wide range of spatial scales, and they are predators—some quite high in their food webs—and may thus reveal the presence, accumulation, and effects of contaminants. We do well by studying them.

RRF is, of course, intrinsically dedicated to raptor conservation, and so we monitor populations, analyze their demography, and find ways to mitigate where indicated. Our membership has been highly successful in identifying and helping to eliminate serious threats to raptor populations. One example was the discovery through radiotelemetry that the pesticide monocrotophos in Argentina was killing wintering Swainson's Hawks (*Buteo swainsoni*) migrating from northern California. Another was the extraordinary detective work and experimentation that revealed the role of the veterinary pharmaceutical diclofenac in driving populations of Asian vultures to near-extinction. And yet another was the establishment of lead-based ammunition residues as virtually the only obstacle to self-sustaining condor populations in North America. Among dozens of other potent, human-related mortality agents worldwide, we find carbofurans that threaten African vulture populations, new-generation rodenticides, electrocution, wire strikes, vehicular collisions, and wind turbine blade strikes, each with its own set of challenges. With these, and the ubiquity of habitat alteration, and the acceleration of climate change, the need for RRF's scientists will remain.

Lastly, and still firmly in the realm of conservation, it is essential that, if raptors are to endure the present flood of environmental perturbation, the public must come to like them, take pleasure in the details of their wild existence, and insist upon action (or inaction) on their behalf. Fortunately, raptors do lend themselves quite appropriately to such appreciation. Here, we have adventurous fathers going off to spectacular, three-dimensional foraging, while even more powerful and resourceful mothers stay home to nurture and defend, both sexes formidable toward trespassers, yet absurdly gentle in the presence of offspring. Raptors are also beautiful, and that never hurts. So, as we do the science, let us not forget the larger audience whose attitudes will ultimately determine the fates of raptor populations. Let us bring the worth and wonder of raptors into the minds of everyone we can, and through whatever medium is at hand. Our research, our meetings, and our journal articles are foundational, but in matters of conservation, they may only be first steps.

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Monday, October 17

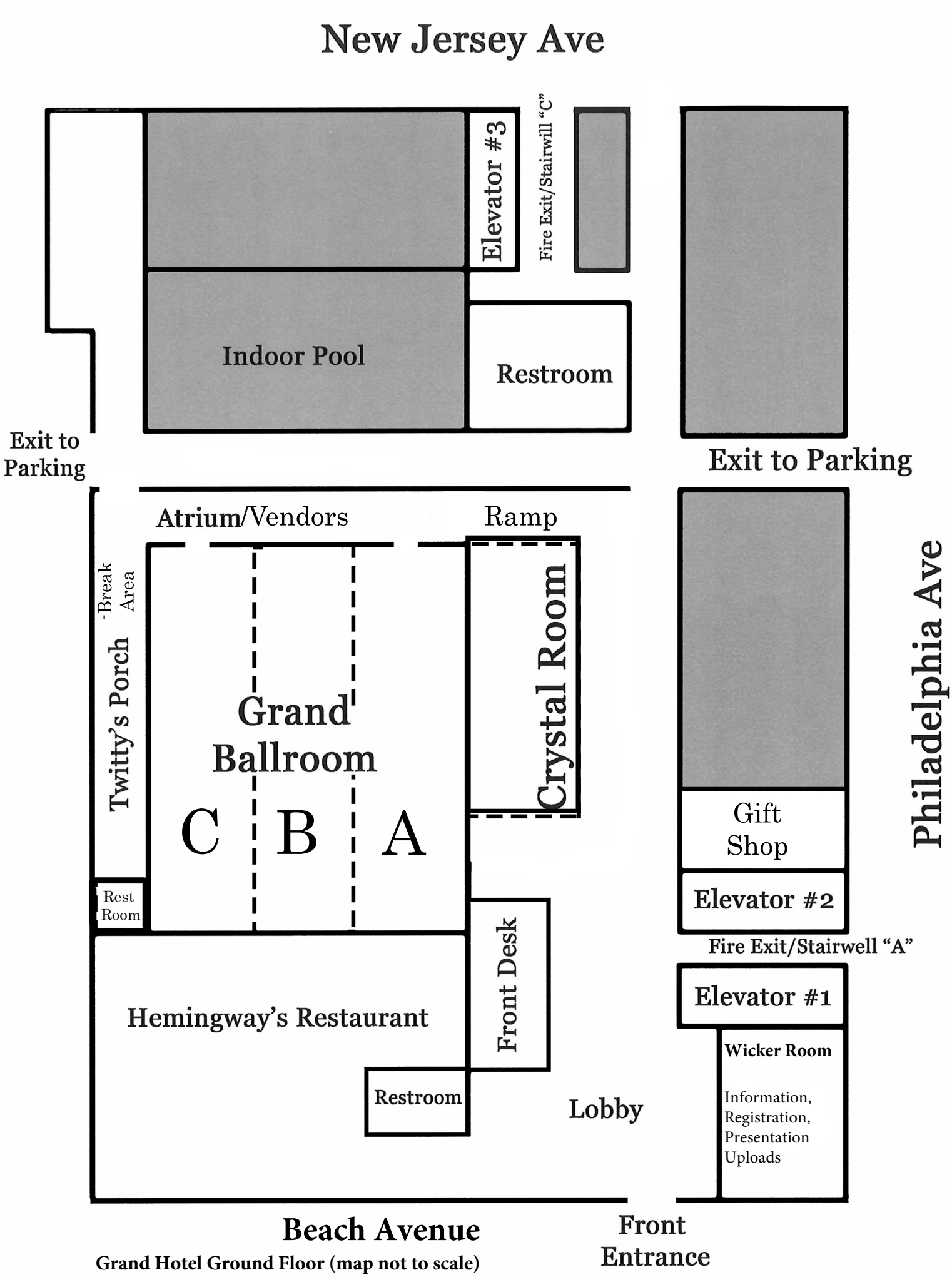
8:00-9:00 AM	Announcements and Plenary by Ian Newton (5th Floor Ballroom)		
9:00-9:40 AM	Second Plenary Talk with Jimmie Parrish, Richard Clark, and David Bird (5th Floor Ballroom)		
9:40 AM	*Break*	*Break*	*Break*
	1st Floor Ballroom A	**1st Floor Ballroom B**	**1st Floor Ballroom C**
	Population Monitoring (Neil Paprocki)	**Urban Raptors Symposium - I (Clint Boal and Cheryl Dykstra)**	**50 Year Anniversary Symposium - I (Jim Bednarz)**
10:00 AM	M. Jensen, Genetics of Eastern Northern Goshawks	J.F. Therrien, History of Urban Raptors	D. Varland, A History of RRF Conferences
10:20 AM	E. Wommack, Population Structure of the American Kestrel	B. Isaac, Raptors in Urban Ecosystems	J. Bednarz A History of the Journal of Raptor Research
10:40 AM	D. Holt, Declining Populations of Snowy Owls in Alaska	C. Dykstra, City Lifestyles: Behavior of Urban Raptors	C. Boal, Raptor Research and Animal Welfare
11:00 AM	J.P. Medina, Owl Occurrence in the Toluca Volacno	B. Mannan, Population Dynamics of Urban-Nesting Raptors	D. Bird, Managing a Kestrel Colony for Forty Years
11:20 AM	D. Holt, Declining Populations of Long-eared Owls	C. Boal, Urban Raptor Communities	P. Spitzer, Ospreys as Menhaden Bioindicators
11:40 AM	D. Oleyar, RPE - Ten Years After SNABP	B. Skipper, Urban Mississippi Kites	T. Katzner, Advances in Tracking Raptors
12:00-1:20 PM	*Lunch*	12:15-1:00 PM - Ellen Paul lunch on Permits and Animarl Warfare (Crystal Room)	*Lunch*
	Migration and Movement - I (Robert Miller)	**Urban Raptors Symposium - II (C. Boal and C. Dykstra)**	**50 Year Anniversary Symposium - II (Lloyd Kiff)**
1:20 PM	J. Brown, Golden Eagle Movements in Western North America	R. Bierregaard, Ospreys in the 21st Century Landscape	C. Henny, Contaminant Research with Raptors at Patuxent
1:40 PM	T. Miller, Bald Eagle Dispersal	R. Cooke, Powerful Owls	J. Pagel, Golden Eagles: Conservation Challenge
2:00 PM	C. DeSorbo, Peregrine Falcon Migration Along the Atlantic	C. Dykstra, Red-shouldered Hawk: An Urban Hack	L. Goodrich, Raptor Migration Monitoring: Past and Future
2:20 PM	B. Linkhart, Migration of Flammulated Owls	B. Mannan, Urban Cooper's Hawks	M. Ferrer, World Class Research in Spain
2:40 PM	R. Crandall, Hawks, Owls, and Wildlife Revisited	O. Krone, Urbanization of the Northern Goshawk in Germany	M. Virani, Raptor Research and Conservation in East Africa
3:00 PM	*Break*	*Break*	*Break*
	Migration and Movement - II (Ross Crandall)	**Urban Raptors Symposium - III (C. Boal and C. Dykstra)**	**50 Year Anniversary Symposium - III (Miguel Saggese)**
3:20 PM	G. Battaly, Weather Patterns at Six NY Region Hawk Watchers	S. Hindmarch, Raptor Mortality in Urban Landscapes	K. Steenhof, A History of Bald Eagle Recovery
3:40 PM	L. Goodrich, Body Condition of Migrating Raptors in PA	L. Arent, Raptor Rehabilitation, Education, and Outreach	T. Cade, History and Status of the Peregrine Falcon
4:00 PM	C. Concepcion, Pacific Open-Water Migration	B. Washburn, Human Raptor Conflicts	L. Severinghaus, East Asian Raptor Research
4:20 PM	N. Paprocki, Spring Migration Counts in AK	D. Bird, Conservation and Management of Urban Raptors	I. Newton, Population Trend, Breeding and Survival
4:40 PM	J. Watson, HWI Band Encounters from the Past 30 years	C. Boal, Urban Raptors: Perspectives and Future Directions	
5:00-6:00 PM	Poster Session (5th Floor Ballroom)		
6:00-8:00 PM	Poster Session Reception (5th Floor Ballroom)		

Tuesday, October 18

8:00-9:00 AM	Announcements and Plenary by Carol McIntyre (5th Floor Ballroom)		
9:00-9:40 AM	Second Plenary Panel: Women in Raptor Research (5th Floor Ballroom)		
9:40 AM	*Break*	*Break*	*Break*
	1st Floor Ballroom A	**1st Floor Ballroom B**	**1st Floor Ballroom C**
	Conservation (Ian Warkentin)	**Snowy Owl Symposium - I (D. Brinker)**	**Speed Talks - 10 minutes each (T. Booms)**
10:00 AM	T. Nygård, The Golden Eagle in Norway	S. Weidensaul, Project SNOWstorm	C. Barger, Blood Lead Levels in AK Golden Eagles / S. Blackshire, Eagle Behavior
10:20 AM	J. Parry-Jones, Vultures, the Most Threatened Bird Group	N. Smith, Wintering Snowy Owls in Massachusetts	K. Simon, Bald Eagle Mortality in MI, 1987-2011 / W. Clark, Winter Nesting of White-tailed Kites in TX
10:40 AM	D. Brinker, Central Appalachian Goshawk Population Change	J.F.. Therrien, Irruptive Movements in Snowy Owls	D. Groff, Identification of Prey of Saw-Whet Owls / K. Loyd, Burrowing Owls: Challenges of Urban Living
11:00 AM	T. Swem, Recovery of Peregrine Falcons, Colville River, AK	D. Brinker, Snowy Owl Molt	J. Hall, Condor Foraging-Associated Risk / R. Galindo, Gray Hawk Fledged Five Juveniles in TX
11:20 AM	T. Ely, Morphological Changes in American Kestrels	E. Miller, Cooperative Snowy Owl Mortality Investigation	R. Van Buskirk, Efficacy of Invertebrates for Lures / J. Elliott, Mitigating Rodenticide Impacts on Raptors
11:40 AM	S. Schulwitz, Recommendations for American Kestrels	T. McDonald, How Snowy Owls Adjust to Declining Habitats	
12:00-1:20 PM	*Lunch*	*Lunch*	*Lunch*
	Methods and Techniques - I (Miguel Saggese)	**Snowy Owl Symposium - II (D. Brinker)**	**Lead and Raptors Symposium - I (T. Katzner)**
1:20 PM	E. Mojica, Hazards During Bald Eagle Migration	S. Weidensaul, Summer Movements of Non-breeding Owls	D. McRuer, Clinical Lead Poisoning in Raptors
1:40 PM	E. Chabot, Simulated Detected of Golden Eagle Passage	T. Miller, Snowy Owl Flight Behavior	J. Fallon, Evaluation and Treatment of Lead Poisoning
	Methods and Techniques - II (Miguel Saggese)	**Short-eared Owl Symposium - I (M. Gahbauer)**	**Lead and Raptors Symposium - II (T. Katzner)**
2:00 PM	S.A. Kane, Diurnal Raptor Take-Off Kinematics	M. Gahbauer, Status of Short-eared Owls in North America	V. Slabe, Blood Lead of Migrant Golden Eagles in MT
2:20 PM	M. Sur, Raptor Flight Behaviors Using Accelerometry	R. Clark, What's Known of Asio flammeus from Literature	V. Slabe, Blood Lead Levels of Piscivorous Raptors
2:40 PM	K. Keith, Engineering Protection for Peregrine Falcons	N. Paprocki, Short-eared Owls Intermountain West 2016	B. Helender, Lead from Ammunition in Swedish Eagles
3:00 PM	*Break*	*Break*	*Break*
	Methods and Techniques - III (moderator)	**Short-eared Owl Symposium - II (M. Gahbauer)**	**Lead and Raptors Symposium - III (T. Katzner)**
3:30 PM	R. Perkins, Transmitter Influences on Raptor Agility	R. Miller, Variation in Breeding of Short-eared Owls	D. Becker, Bald Eagle Lead Exposure in the Upper Midwest
3:40 PM	M. Saggese, Handling and Restraining Raptors	L. Errickson, Winter Roost Selection of Short-eared Owls	C. Parish, Lead Reduction and the Condor
4:00 PM	I. Szabo, Keeping Raptor Researchers and Volunteers Safe	P. Novak, Wintering Short-eared Owls in New York State	H. Van Doninck, Reducing Lead Poisoning With Hunters
4:20 PM	B. Peterjohn, Bird Banding Permits	L. Takats Priestley, Short-eared Owl Nomadic Invasions	Panel Discussion
4:40 PM	B. Peterjohn, discussion	T. Booms, Short-eared Owl Movements	Panel Discussion
5:30-7:30 PM	Dinner Cruise on Cape May		

Wednesday, October 19

8:00-9:00 AM	Announcements and Plenary by Yossi Lesham (5th Floor Ballroom)		
9:00 AM	*Break*	*Break*	*Break*
	1st Floor Ballroom A	**1st Floor Ballroom B**	**1st Floor Ballroom C**
	Northern Saw-whet Owl Symposium - I (K. Duffy)	**Anderson Award (moderator)**	**Raptor Health - I (Brian Washburn)**
9:20 AM	D. Brinker, Saw-whet Owl Migration Overview	A. La Porte, Gray Hawk Expansion in the San Pedro River Valley	D. Scott, Survival of Raptors Released after Rehabilitation
9:40 AM	D. Panko, Roost Sites of Saw-whets in Southeastern NY	S. Pourzamani, Nest Defense and Alarm Calling in Burrowing Owls	B. Dudek, Abundance of Ectoparasites in Golden Eagle Nests
10:00 AM	K. Kleiner, Kin Associations in Migrating Northern Saw-whet Owls	C. Vennum, Demography and Ecoimmunology in Swainson's Hawks	J. Barnes, Mercury in Peregrines in Coastal Washington
	Northern Saw-whet Owl Symposium - II (K. Duffy)	**Cautions for Conservation and Taxonomy (Ben Skipper)**	**Raptor Health - II (Brian Washburn)**
10:20 AM	W. Mollhoff, Northern Saw-whet Owl Nest Box Study in Nebraska	W. Clark, Contrasting Molecular and Morphological Evidence	S. Hindmarch, Rats! What Triggers Us to Control for Rodents
10:40 AM	A. Lycke, Northern Saw-whet Owl Nest-Box Occupation	C. McClure, The Power and Peril of Nest Boxes	
11:00 AM	*Break*	*Break*	*Break*
	Behavior - I (Rob Bierregaard)	**Breeding and Behavior of Owls (Dave Oleyar)**	**Habitat Use - I (Jesse Watson)**
11:20 AM	T. Katzner, Breeding Biology of Red-Footed Falcons	S. Hiro, Synchronous Hatching of Northern Pygmy Owls	P. Kennedy, Meta-analysis of Goshawk Literature
11:40 AM	M. Lanzone, Quantifying Behavior with High Frequency GPS	M. Larson, Breeding Ecology of Northern Hawk Owls in Montana	R. McCabe, Nest-Site Selection by Broad-winged Hawks
12:00-1:20 PM	*Lunch*	*Lunch*	*Lunch*
	Behavior - II (Jemima Parry-Jones)	**Energy Infrastructure - I (Libby Mojica)**	**Habitat Use - II (Joan Morrison)**
1:20 PM	P. López-López, Bonelli's Eagles Tracked in Spain	S. Poessel, Flight Response of California Condors	M. Larson, Winter Roost Sites of Saw-whet Owls in Montana
1:40 PM	V. Morandini, Sex Ratio Adjustment in Colonization Processes	C. Frank, Identifying Collision Risk Areas for Bald Eagle	D. Varland, Scavenging in Peregrine Falcons
2:00 PM	P. Spitzer, Belize Osprey Nest Survey	K. Peters, Machine Vision Monitoring and Eagle Fatality Risk	K. Harrington, Feeding Behavior of Striated Caracaras
2:20 PM	V. Morandini, Juv. Dispersal Patterns: Spanish Imperial Eagle	J. Luzenski, Power Line Collision Risk Assessment	K. Mason, What is Happening with Kestrels at the Dump
2:40 PM	F. Atuo, Raptor Assemblages and Niche Characteristics	A. Duerr, Eagle Resting Locations Driven by Flight	M. Steele, Juvenile Pallas's Fish Eagle Migration in Asia
3:00 PM	*Break*	*Break*	*Break*
	Behavior - III (Jim Bednarz)	**Energy Infrastructure - II (Adam Duerr)**	
3:20 PM	D. Bird, Drones and Raptor Research	S. Lewis, Bald Eagle Movement Strategies	
4:00-4:40 PM	RRF Members Business Meeting		
5:00-6:00 PM	Banquet Social Hour and Cash Bar (5th Floor Ballroom)		
6:00-8:30 PM	Banquet (5th Floor Ballroom)		
8:30-11:30 PM	Party (5th Floor Ballroom)		



Grand Hotel Ground Floor (map not to scale)