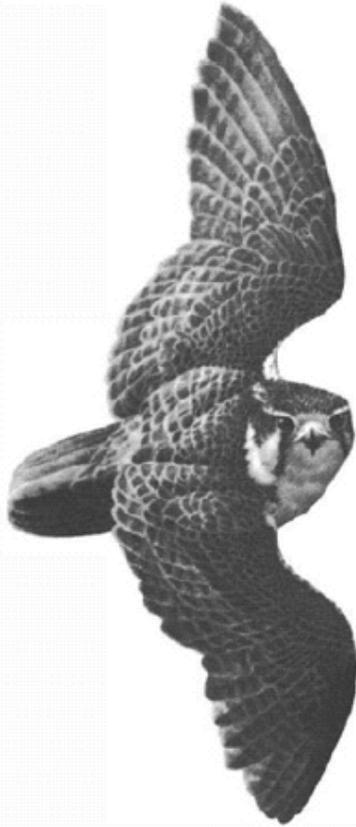


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**RAPTOR  
RESEARCH  
FOUNDATION**

**CALIFORNIA  
HAWKING  
CLUB**

**PROGRAM and ABSTRACTS**  
Raptor Research Foundation  
2004 Annual Meeting

**DOUBLETREE HOTEL  
BAKERSFIELD, CALIFORNIA  
NOVEMBER 10-13, 2004**

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**CONTRIBUTORS**

Albion Environmental, Inc.  
Golden Gate Raptor Observatory  
Green Diamond Resources Company  
Hawkwatch International

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## **MEETING AT A GLANCE**

### **Board Meetings**

RRF: Wednesday, November 10  
8:00 am - 5:00 pm  
Buena Vista Room

CHC: Friday, November 12  
6:00 am - 10:00 am  
Buena Vista Room

### **Business Meetings**

RRF: Friday, November 12  
8:00 am – 10:00 am  
Kern River Room  
All members are welcome.

CHC: Friday, November 12  
7:00 pm – 8:00 pm  
Buena Vista Room

### **Program**

Wednesday, November 10  
8:00 am – 5:00 pm, Main Lounge

Burrowing Owl Meeting

Thursday, November 11  
8:00 am - 12:00 pm, Sierra Room  
8:30 am - 9:45 am, Ballroom  
10:15 am - 5:00 pm  
San Joaquin/Kern River  
and Buena Vista Rooms  
6:00 pm – 9:00 pm  
Nevada and Sierra Rooms

CHC Apprentice Workshop  
Welcome and Keynote Presentation  
Paper Sessions

Poster Session

Friday, November 12  
8:00 am – 6:00 pm  
Nevada and Sierra Rooms  
10:15 am - 5:00 pm  
San Joaquin/Kern River  
and Buena Vista Rooms  
7:00 pm – 8:00 pm  
Buena Vista Room

Poster Viewing

Paper Sessions

West Nile Virus Meeting

Saturday, November 13  
6:30 am – 12:00 pm  
8:00 am – 6:00 pm  
Nevada and Sierra Rooms  
12:30 pm – 4:00 pm  
1:30 pm - 4:00 pm  
San Joaquin/Kern River  
and Buena Vista Rooms

Sky Trials  
Poster Viewing

Telemetry Fox Hunt  
Paper Sessions

**Social Events**

- Wednesday, November 10  
6:00 pm - 9:00 pm                      Joint RRF/CHC Welcome Reception and Cash Bar
- Friday, November 12  
6:00 pm - 9:00 pm                      Barbeque at the California Living Museum
- Saturday, November 13  
6:00 pm - 12:00 am                      Banquet and Awards Presentation, Main Ballroom

**Field Trips**

- Saturday, November 13  
7:30 am - 12:00 pm                      Birding Truxtun Lake and visit to the Facility for Animal Care and Treatment (FACT)

We will first visit Truxtun Lake along the Kern River for ducks, cormorants, pelicans, and shorebirds. A Kern Audubon Society local will be your guide. Then we will visit the Facility for Animal Care and Treatment (FACT) at California State University, Bakersfield. FACT's mission is to serve as a wildlife rescue, conservation and education project for the University. The community, the university, and local wildlife, especially birds of prey and endangered species, have benefited from this facility since 1975. Non-releasable raptors on display include Golden Eagle, several buteos, Great Horned Owl, Peregrine Falcon, Prairie Falcon, American Kestrel, and Burrowing Owls. Also see <http://www.csub.edu/FACT/>.

- Saturday, November 13                      Birding Hart Park and visit to the California Living  
7:30 am - 12:00 pm                      Museum (CALM)

We will first go birding at Hart Park in Bakersfield, a premier birding spot along the Kern River. Over 231 species of birds have been recorded in the park alone. Waterfowl, cormorants, pelicans, herons, shorebirds, sparrows, and warblers are frequently seen at this time of year. Then we'll visit the California Living Museum (CALM), which displays and interprets non-releasable native animals and plants in replicated communities. Some of California's endangered species and raptors can be seen here. CALM also displays Miocene fossils. Also see <http://www.calmzoo.org/>.

- Saturday, November 13                      California Hawking Club Sky Trials  
6:30 am - 12:00 pm

Join the California Hawking Club for their annual competition. The event entails falconers putting their longwings into a pitch and releasing a homing pigeon for capture at the height of their raptor's flight. Points are awarded for the height of the pitch as well as several elements of the falconer's control of their bird. The quarry is rarely captured. The falconer/hawk combination with the highest point scores wins.

Sunday, November 14,  
7:00 AM - 5:00 PM

California Condor Recovery Program

The California Condor is being reintroduced into its former range in the mountainous areas of southern and central coastal California. There are 47 condors now flying free in California. The Raptor Research Foundation is a strong and outspoken advocate of the captive breeding program begun in 1980, which saved the species from extinction. The field trip will travel through condor habitat where we can view recent nests as well as current threats to the species. Our destination will be Hopper Mountain National Wildlife Refuge where condors have been reintroduced since 1992. There will be opportunities to view numbers of condors soaring over the refuge and feeding. Bring binoculars and warm clothing.

The field trip leaders will be Jesse Grantham, a US Fish and Wildlife Service biologist who worked on the species from 1980 to 1986, and works with the species presently, and Dr. Allan Mee, a condor researcher with the San Diego Zoological Society.

## GENERAL INFORMATION

### Bakersfield and the Surrounding Area

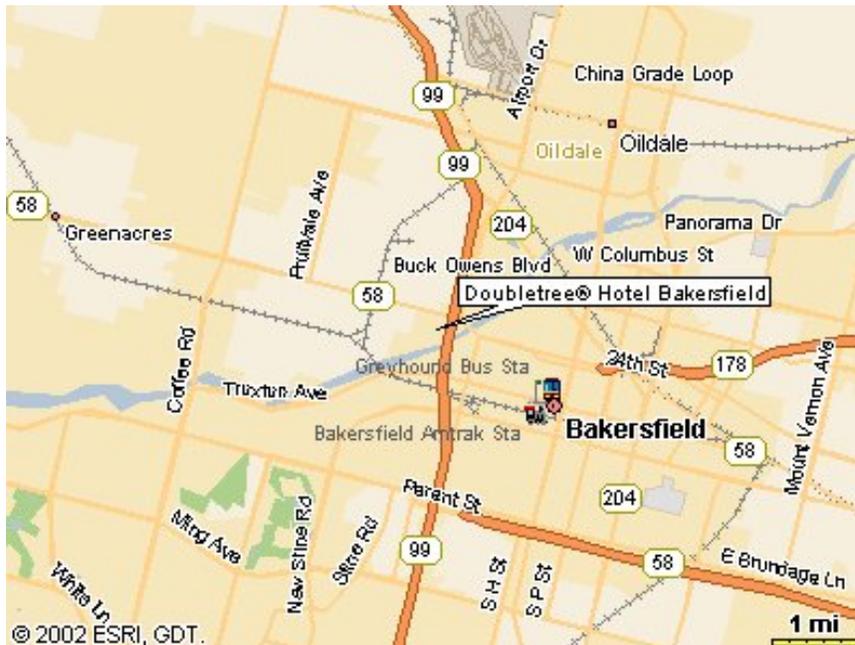
Bakersfield – “A Riverbed Runs Though It” – is the 13<sup>th</sup> largest city in California. Bakersfield is located at the southern end of the San Joaquin Valley, and is flanked on the west by the Tehmlor Mountain Range, on the south by the Tehachapi Mountains and on the East by the Sierra Nevada. The Kern River flows though the valley, adding natural beauty to the area. Bakersfield was designated an “All American City” by the Civic League in 1990. Bakersfield is the county seat of Kern County, which is the leading oil-producing county in the continental U.S. and is the fourth most productive agricultural county in the nation. Grapes, citrus, cotton, Market Milk, and almonds are the top five crops.

Northeast of Bakersfield lies the Kern River Valley, an annual migration location for tens of thousands of Turkey Vultures. The mountains surrounding the San Joaquin Valley are home to very rare California Condors. The west side of Kern County is the winter home to hundreds of raptors, while Pixley National Wildlife Refuge, winter home to thousands of Sandhill Cranes and other birds, is an hour north. Information on Kern County biological resources can be found at <http://natureali.org>.

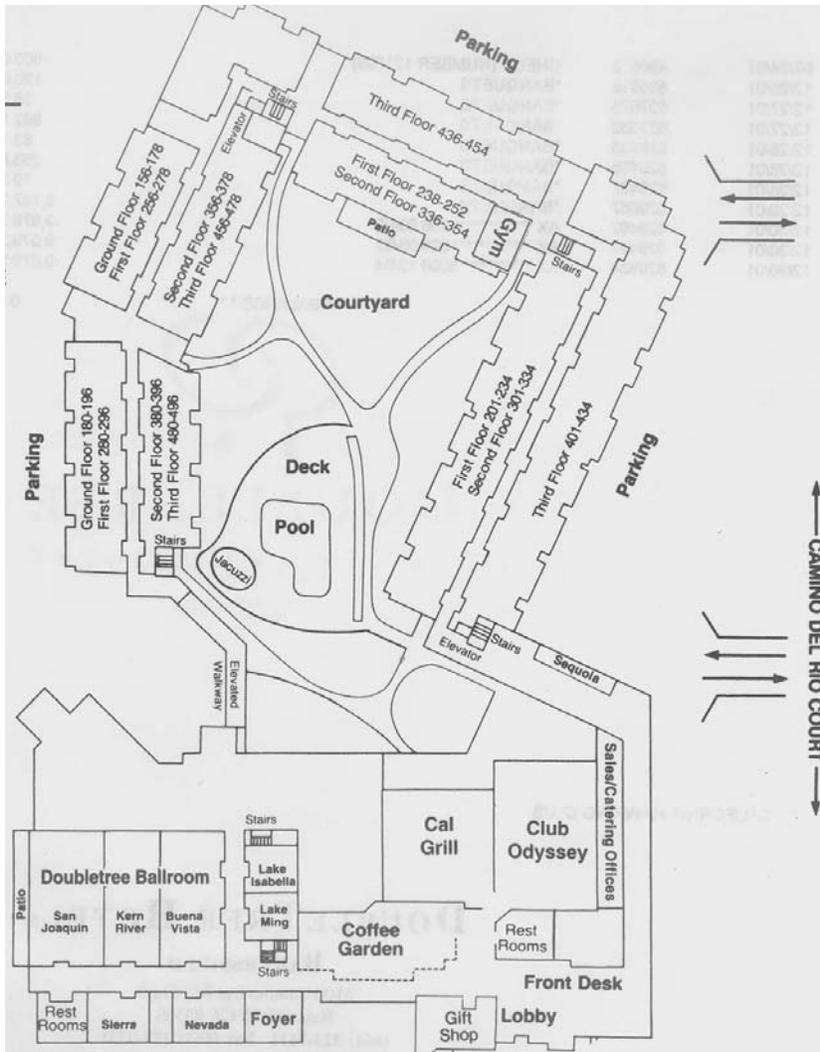
Bakersfield temperature in November averages 55° F and ranges from 68° - 42° F. It is likely to be cool in the mornings and at night, with shirt sleeve weather during the day.

### Meeting Location

The Doubletree Hotel – Bakersfield is located at 3100 Camino Del Rio Court, Bakersfield, CA, USA. Telephone is 1-661-323-7111.



To get there from Meadows Field: Take Airport Drive south, get in far left lane. Airport Drive turns into Highway 99 South. Take Rosedale Highway Exit, and the hotel is located on the left.



The Doubtree Hotel Bakersfield has a business center, fitness facility, restaurant and club, and indoor and outdoor pools. Hotel parking is \$3.00/day.

### Registration

Registration will be held in the Rosedale Room from 4 -8 pm on Tuesday, and from 7:30 am to 5:00 pm all other days.

### Slide Previewing

Presentations may be previewed in the Sequoia Room from 4-8 pm on Tuesday, 10 am to 8 pm on Wednesday, 8 am to 8 pm on Thursday and Friday, and 1-5 pm on Saturday.

### Paper Sessions

Paper sessions will run concurrently throughout the conference in the San Joaquin/Kern River and the Buena Vista Rooms.

### Poster Session

Poster presenters should set up their posters between 1 pm and 6 pm on Thursday, November 11 in the Sierra/Nevada Room. Posters should remain up for viewing during the entire conference; however, please remove them by 6 pm on Saturday, November 13.

**Vendors/Exhibitors**

Vendors and exhibitors will be set up from 8 am to 10 pm daily (except Tuesday) in the Lake Rooms.

**Friday Evening Barbeque**

The Friday evening barbeque will be from 6 -9 pm at the California Living Museum. Please check at the registration desk for details.

**Awards Banquet**

The conference banquet, awards ceremony, and raffle will be from 6 pm to midnight on Saturday, in the Doubletree Hotel Main Ballroom. Please check at the registration desk for details.

**Thursday, November 11**

**8:30 - 9:45 am**

**Main Ballroom**

**Welcome and Keynote Address**

Falconry in the United States in 2004

**Brian Millsap**, President, Raptor Research Foundation

**San Joaquin / Kern River Rooms**

**Buena Vista Room**

10:20 - 10:40 am

**Management of Raptor**

**Electrocutions in the Southwestern  
United States**

Electrical Aspects of a Changing Environment.  
**Andrew S. McBride.**

**Population Monitoring and  
Conservation**

Mitochondrial DNA Analysis of Northern  
Spotted Owl (*Strix occidentalis caurina*) and  
California Spotted Owl (*Strix occidentalis  
occidentalis*) Populations. **Tonja Y. Chi**,  
Andrea L. Henke, Jerry J. Smith, and Chris  
Brinegar.

10:40 - 11:00 am

Raptor Electrocution: Causes and Preventions.  
**Andrew S. McBride** and Victoria Joseph.

DNA Analysis of Naturally Molted Feathers for  
Expanded Raptor Monitoring with Examples  
from Spotted Owls (*Strix occidentalis*).  
**Andrea L. Henke**, Tonja Y. Chi, Jerry J.  
Smith, and Chris Brinegar.

11:00 - 11:20 am

Selecting Electrical Distribution Poles for  
Priority Retrofit to Reduce Raptor Mortality.  
**K. Shawn Smallwood**, Carl G. Thelander, Brian  
Karas, Daniel Pearson, Tracey Alsobrook, and  
Mark Dedon.

The Conservation of the Western Burrowing  
Owl (*Athene cunicularia hypugaea*). **Geoff  
Holroyd**, Jason Duxbury, and Helen Trefry.

11:20 - 11:40 am

Mitigating Raptor Electrocution in Tucson,  
Arizona. **James F. Dwyer** and R.W. “Bill”  
Mannan.

Annual Dispersal of Burrowing Owls (*Athene  
cunicularia*) in the Northern Great Plains.  
**Jason Duxbury** and Geoff Holroyd.

## Thursday, November 11

**San Joaquin / Kern River Rooms**

**Buena Vista Room**

11:40 am - 12:00 pm

**Management of Raptor  
Electrocutions in the Southwestern  
United States (cont.)**

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Resolving Raptor Issues on the Path 15 Transmission Line Project in California's Central Valley. **John M. Bridges** and Steve Rock.

**Population Monitoring and  
Conservation**

---

Are American Kestrel Populations in a State of Decline in North America? **David M. Bird**, Keith L. Bildstein, Daniel R. Ardea, Karen Steenhof, John Smallwood, Joanne Mason, Mike Maurer, Mark F. Causey, David Mossop, Antonio DiBernardo, Robbin Lindsay, Don McCartney, and John Hendrickson.

12:00 - 1:40 pm

### Lunch

1:40 – 2:00 pm

Response of Avian Predators to the Construction of a High Voltage Electric Transmission Line in Northeastern Nevada. **Wendy M. Lammers** and Michael W. Collopy.

Re-evaluating the Conservation Status of the Critically Endangered Madagascar Fish Eagle (*Haliaeetus vociferoides*): Historical Population Decline or a Naturally Small Population? **Ruth E. Tingay**, Michele L. Clarke, and Melanie Culver.

2:00 – 2:20 pm

Study Design Issues in Raptor Electrocution Research - A Review. **Robert N. Lehman**, Patricia L. Kennedy, and Julie A. Savidge.

Goshawks (*Accipiter gentilis*) Passing through Duluth, Minnesota: From Two Distinct Locations? **Shawn E. Hawks**, James W. Grier, and David L. Evans.

2:20 - 2:40 pm

**Conservation Management**

---

Avian Protection Plans and National Wildlife Refuges. **Richard E. Harness** and Lori A. Nielsen.

First Known Specimen of a Hybrid Buteo: Swainson's Hawk x Rough-legged Hawk From Louisiana. **William S. Clark** and Christopher C. Witt.

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## Thursday, November 11

### San Joaquin / Kern River Rooms

### Buena Vista Room

2:40 – 3:00 pm

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#### Conservation Management (cont.)

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#### Raptor Ecology

Twenty-five Years of Bald Eagle Restoration in Southern California and the Continuing Effects of DDT. **Peter B. Sharpe** and David K. Garcelon.

Duking It Out: Factors that Influence Sibling Aggression in Red-shouldered Hawk Nestlings. **Kathleen Townsend** and James C. Bednarz.

3:00 – 3:20 pm

#### Break

3:20 - 3:40 pm

Strangers in a Strange Land: Lower Apparent Survival Rates for Hacked than Wild-reared Aplomado Falcons. **Jessi L. Brown**, Erin J. Gott, and Paul W. Juergens.

Open

3:40 - 4:00 pm

Native Raptor Species in Free Flight at the Arizona-Sonora Desert Museum. **Sue Tygielski**.

An Anatomical Comparison of the Hindlimb and Jaw of North American Hawks and Falcons in Relation to Prey Procurement. **Diego Sustaita** and Fritz Hertel.

4:00 - 4:20 pm

---

#### West Nile Virus and Other Diseases

Beak Abnormalities Among Buteos on the Pacific Coast of North America. **Clifford M. Anderson**.

Instances of Apparent Prey Specialization by Galápagos Hawks Engaged in Rearing Young. **Kenneth M. Levenstein**, Dave Giordano, James C. Bednarz, Adriana Lara Meza, Pilar Jimenez, and Marco Aguilar.

4:20 - 4:40 pm

Prevalence and Host-Specificity of Blood Parasites in California Raptors: Conservation Perspectives from a Molecular Approach. **Ravinder Sehgal**, Buzz Hull, Nancy Anderson, and Lisa Tell.

Plumages of Basic II and Basic III light-morph Rough-legged Hawks. **William S. Clark** and Peter H. Bloom.

**Thursday, November 11**

**San Joaquin / Kern River Rooms**

**Buena Vista Room**

4:40 - 5:00 pm

**West Nile Virus and Other Diseases  
(cont.)**

**Raptor Ecology (cont.)**

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Raptor Mortality due to West Nile Virus in  
Several States, 2002. **Emi K. Saito**, Louis Sileo,  
D. Earl Green, Carol U. Meteyer, Douglas E.  
Docherty, Grace S. McLaughlin, and Kathryn A.  
Converse.

---

Ecological Correlates of Swainson's Hawk  
(*Buteo swainsoni*) Nesting Success in the Butte  
Valley, California. **Christopher W. Briggs**,  
Michael W. Collopy, and Brian Woodbridge.

6:00 - 9:00 pm

**Sierra / Nevada Rooms**

**Poster Session**

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## Friday, November 12

### San Joaquin / Kern River Rooms

### Buena Vista Room

10:20 - 10:40 am

#### Raptor Ecology (cont.)

Nestling Sex Ratio Variation in Burrowing Owls (*Athene cunicularia*). **Nicole A. Taylor** and James R. Belthoff.

#### Habitat Management and Research

Nest-site Selection by Cooper's Hawks (*Accipiter cooperii*) on Managed Timberlands in the Coastal Redwood Region of Northern California. **Laura C. Bradley**, Sal J. Chinnici, and David Bigger.

10:40 - 11:00 am

Prehistoric Hunting of California Condors (*Gymnogyps californianus*) and Bald Eagles (*Haliaeetus leucocephalus*) on the Columbia River. **Victoria J. Hansel-Kuehn**.

Short-term Effects of Timber Harvest on Northern Goshawk (*Accipiter gentilis*) Breeding Area Occupancy, Nest Success, and Productivity. **Brian W. Moser** and Edward O. Garton.

11:00 - 11:20 am

An Overview of Factors Influencing Male Productivity in Merlins. **Ian G. Warkentin**, Richard H.M. Espie, Paul C. James, and David J. Lieske.

A Habitat Predictability Model for Golden Eagles (*Aquila chrysaetos*) on Private Timberlands in Coastal Northern California. **Daniel R. Dill**, Sal J. Chinnici, and David Bigger.

11:20 - 11:40 am

Open

Swainson's Hawk (*Buteo swainsoni*) Use of Vineyard Areas in the Lower Mokelumne River Watershed, California. **Craig A. Swolgaard**, Douglas A. Bell, and Kent A. Reeves.

11:40 am - 12:00 pm

Vocal Development in American Kestrel (*Falco sparverius*) Nestlings. **John A. Smallwood**, Valerie Dudajek, Sivajini Gilchrist, and Mary Anne Smallwood.

The Flight Patterns of Red-tailed Hawks (*Buteo jamaicensis*) in Landscapes Fragmented by Agriculture. **Joelle L. Gehring** and Harmon Weeks, Jr.

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## Friday, November 12

### San Joaquin / Kern River Rooms

### Buena Vista Room

12:00 - 1:40 pm

#### Lunch

1:40 - 2:00 pm

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#### Raptor Ecology (cont.)

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#### Habitat Management and Research (cont.)

Open

Accuracy Assessment of Argos PTT Locations for Tracking Red-tailed Hawks (*Buteo jamaicensis*). **Derek J. Craighead** and Roger N. Smith.

2:00 – 2:20 pm

Nesting Ecology of Urban Cooper's Hawks in Berkeley, California. **Ralph Pericoli** and Allen M. Fish.

An Evaluation of Solar-Powered GPS Transceivers Used to Monitor California Condor (*Gymnogyps californianus*) Movement. **Richard C. Mykut**, Kelly Sorenson, Eric Stover, and Jessica Koning.

2:20 – 2:40 pm

Observations of Arboreal Foraging in Migrant Swainson's Hawks (*Buteo swainsoni*): A New Alternative Hypothesis to the Fasting Migration Model. **Jack Kirkley**.

Monitoring Movements and Foraging of Bald Eagles (*Haliaeetus leucocephalus*) Reintroduced on the Northern Channel Islands, California using Solar Argos/GPS PTTs and VHF Telemetry. **Jessica A. Dooley**, Peter B. Sharpe, and David K. Garcelon.

2:40 – 3:00 pm

Allometry of Alarm Calls: Black-capped Chickadees (*Poecile atricapilla*) Encode Information About Raptor Size in Their Mobbing Calls. Christopher N. Templeton, Erick Greene, and **Kate Davis**.

Modeling a Population of Ferruginous Hawks Based on Nest Substrate Selection within the Natural Gas Matrix: An Initial Investigation. **Mike C. Neal**.

3:00 – 3:20 pm

#### Break

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## Friday, November 12

### San Joaquin / Kern River Rooms

### Buena Vista Room

3:20 – 3:40 pm

#### Raptor Ecology (cont.)

Politics at the Nest: Unusual Reproductive Strategies Amongst Cooperatively Breeding Madagascar Fish Eagles (*Haliaeetus vociferoides*). **Ruth E. Tingay** and Michele L. Clarke.

#### Habitat Management and Research (cont.)

Use of Time-lapse Video Surveillance Systems to Monitor Raptor Nests. **Troy J. Bader**, Eugene A. Jacobs, Kathleen A. Townsend, and James C. Bednarz.

3:40 – 4:00 pm

Short and Sweet: The Post-Fledging Dependence Period of Golden Eagles (*Aquila chrysaetos*) in Denali National Park and Preserve, Alaska. **Carol L. McIntyre** and Michael W. Collopy. Open

4:10– 4:55 pm

#### **Special Presentation**

Raptors in Arabia: Their Ecology and Use in Falconry. **Joseph B. Platt**, PCR Services Corp., Irvine, California

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## Saturday, November 13

### San Joaquin / Kern River Rooms

1:40 – 2:00 pm

#### **Habitat Management and Research (cont.)**

Roadside Raptor, Loggerhead Shrike (*Lanius ludovicianus*) and Common Raven (*Corvus corax*) Surveys in the Carrizo Plain National Monument, San Luis Obispo County, California. **Sam D. Fitton.**

2:00 - 2:20 pm

Landscape Characteristics of Mississippi Kite Nests in Arkansas. **Amy St. Pierre** and James C. Bednarz.

2:20 - 2:40 pm

Foraging and Singing Habitat of Flammulated Owls (*Otus flammeolus*) in Colorado. **Brian D. Linkhart** and Richard T. Reynolds.

2:40 - 3:00 pm

Thermal Protection from Canopy Cover: Analysis of Red-tailed Hawk Nest Temperatures. Derek Craighead, **Bryan E. Bedrosian**, and Roger N. Smith.

3:00 - 3:20 pm

#### **Break**

3:20 - 3:40 pm

Nest Site Characteristics and Productivity of Peregrine Falcons (*Falco peregrinus*) in Southern Ontario. **Marcel A. Gahbauer** and David M. Bird.

3:40 - 4:00 pm

Response of Nesting Prairie Falcons and Golden Eagles to Loss of Shrub Habitats in the Snake River Birds of Prey National Conservation Area. **Michael N. Kochert** and Karen Steenhof.

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## **ABSTRACTS**

*(IN ALPHABETICAL ORDER BY FIRST AUTHOR'S LAST NAME)*

**KEYNOTE ADDRESS: FALCONRY IN THE UNITED STATES IN 2004**

**BRIAN A. MILLSAP**, Division of Migratory Bird Management, U.S. Fish and Wildlife Service, 4401 N. Fairfax Drive, MS MBSP-4107, Arlington, VA 22203 USA.

The 2004 Raptor Research Foundation (RRF) Meeting is being held in conjunction with the California Hawking Club's annual field meet. This affords a unique opportunity for RRF members who are not familiar with the practice of falconry to learn first hand about the sport. The aim of this presentation is to help RRF members make the most of this opportunity by providing background information on the vocabulary, equipment, birds, regulations, and current issues associated with falconry in the United States today.

**BEAK ABNORMALITIES AMONG BUTEOS ON THE PACIFIC COAST OF NORTH AMERICA**

**CLIFFORD M. ANDERSON**, Falcon Research Group, Box 248, Bow, WA 98232 USA.

Serious beak abnormalities have been observed and reported in 40 wild Red-tailed hawks (*Buteo jamaicensis*) and one Rough-legged Hawk (*B. lagopus*) in the three westernmost states and British Columbia. First discovered in 1997 in Washington State, the "long-billed" syndrome is characterized by abnormal growth of the maxilla and mandible. X-rays indicate that it results from accelerated growth of the keratin sheath and not the underlying bone. Thirty-six of these records are from the Puget Sound basin in western Washington, two each are from California and British Columbia and one is from Oregon. Adult birds of both sexes are involved, as are both resident and migrant individuals. As the condition develops, the maxilla extends (often grotesquely) and the overgrown beak becomes unmistakably prominent. The tip may break off and form a square or blunt end ("square bill" form) which apparently impedes feeding and leads to starvation. In other cases maxillae may continue to grow and eventually misalign producing the "cross-bill" form or they may curve around to enclose the mandible tip and prevent the bird from opening its beak fully ("hooked bill" form). In another example, the keratin from the mandible is forced to grow parallel inside the curve of the maxilla creating a "double scimitar" form. In most cases the keratin has a white, flaky appearance. Affected birds often carry high densities of feather lice, probably as a combined result of impeded preening and low condition. Under most circumstances affected birds are easily identified and should be reported. The cause of this syndrome is currently unknown.

**USE OF TIME-LAPSE VIDEO SURVEILLANCE SYSTEMS TO MONITOR RAPTOR NESTS**

\***TROY J. BADER**, PO Box 599 State University, Arkansas 72467. **EUGENE A. JACOBS**, 1601 Brown Deer Lane, Stevens Point, WI 54481, **KATHLEEN A. TOWNSEND** and **JAMES C. BEDNARZ**, PO Box 599 State, University, Arkansas 72467, USA.

Traditionally, monitoring raptor nests to collect behavioral or prey delivery data, requires continuous observations, and often construction of an elevated blind. Thus, collection of such data is extremely time consuming. With the use of time-lapse video surveillance systems, monitoring raptor nest can be done 24 hrs a day, for many consecutive days. Also occurrences at

night, such as predation events, may be documented with infrared illumination systems. In the spring and summer of 2004, we used video surveillance systems to monitor Red-shouldered Hawk (*Buteo lineatus*) and Mississippi Kite (*Ictinia mississippiensis*) nests in Arkansas. We deployed two different types of video surveillance systems. The overhead system involves mounting a small camera to a tree limb or to the trunk of a tree approximately, .5 m -1m above the nest. The second type was the Fuhman system may be mounted anywhere up to 23 m away. This system is equipped with an 18X optical and 30X digital zoom so the camera can be adjusted for a tight or a wide view of the nest. Both systems are equipped with infrared illumination and use a multiple setting time-lapse VHS recorder that is powered by 12 volt deep cycle batteries. Each system had advantages and disadvantages, but both were versatile enough to work in several different situations day or night. These systems have provided various types of data, including: parental-care, behavior, prey-delivery rates, types of prey delivered, and sibling rivalry. With these systems, we have also documented siblicide, cannibalism, and predation events. The use of these video surveillance systems has enabled us to increase sample size as well as collect important ecological data that will aid in the conservation of these species.

### **THERMAL PROTECTION FROM CANOPY COVER: ANALYSIS OF RED-TAILED HAWK NEST TEMPERATURES**

**DEREK CRAIGHEAD, BRYAN BEDROSIAN, and ROGER N. SMITH**  
Beringia South Research Institute, Box 160, Kelly, WY 83011, USA

Most nest site selection studies on raptors focus on a small area directly surrounding the nest tree for insight on what, if any, habitat characteristics are being selected for. However, selection may occur on a smaller scale based on vegetation directly above the nest which may lessen thermal stress throughout the nesting period. Likewise, the nest structure itself may provide thermal protection, with each breeding pair producing a nest with differing thermal buffer qualities. We tested these two theories by recording temperature data in 11 Red-tailed Hawk (*Buteo jamecensis*) nests throughout the breeding season. We found that most nests provided a buffer against temperature extremes post-incubation (corresponding to leaf-out), and each nest provided differing qualities of protection. Our data suggests that both canopy cover directly above the nest and the nest structure provide thermal protection for the young during the nestling period, but not during incubation.

### **ARE AMERICAN KESTREL POPULATIONS IN A STATE OF DECLINE IN NORTH AMERICA?**

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02738, USA; MARK F. CAUSEY, 26821 Overlook St., Damascus, MD 20872, USA; DAVID MOSSOP, Dept. Arts and Science, 500 College Dr., P.O. Box 2799, Whitehorse, YT, Y1A 5K4, Canada; ANTONIO DIBERNARDO and ROBBIN LINDSAY, Canadian Science Centre for Human and Animal Health, 1015 Arlington St., Winnipeg, MB R3E 3R2, Canada; DON MCCARTNEY, 65935 Sisemore Rd., Bend, OR 97701, USA; and JOHN HENDRICKSON, Kestrels Across America, P.O. Box 36, Clipper Mills, CA 95930, USA.

The American Kestrel (*Falco sparverius*) is the most common small falcon in North and Central America. It has adapted to a wide variety of habitats including agricultural landscapes, desert scrub, boreal forest, and urban centers. This hole-nesting species also readily uses nest-boxes, which greatly facilitates population studies. Despite the wide distribution and common status, there are indications of a population decline, at least on a regional basis. The number of kestrels sighted on Christmas Bird Counts show significant declines between 1978 and 1998 in 64 percent (127 of 198) of count circles and significant increases in only 3 percent (6 of 198). Mean annual indices of American Kestrel counts by state or province decreased significantly in all states and provinces, except Ontario and Quebec. According to the Ontario Breeding Bird Atlas though, the range of the kestrel in that province does appear to be contracting. More disturbing is the news that of 90 nest boxes checked in a Yukon program in 2004, only one pair was successful! From 1983 to the present, this population may have undergone a 90 percent decline. In a 2004 survey of 139 nest boxes at Hawk Mountain, Pennsylvania, only 34 of the 49 nesting pairs this season hatched eggs, the fewest on record. From 2002 to 2003, the number of breeding pairs dropped 30%, and from 2003 to 2004 it dropped 13%. Similar declines in other nest box populations have been observed in Virginia, New Jersey, and Massachusetts. In contrast, nest box populations are either stable or even increasing in western states such as Idaho, California and Oregon. Unfortunately, data recording practices have not been uniform across the continent, so comparisons at this stage to detect a continent-wide trend may be futile. Potential causes of observed declines include increased predation by Cooper's Hawks (*Accipiter cooperii*), West Nile virus, changes in agricultural land practices, climatic changes, the ubiquitous presence of brominated flame retardant residues (polybrominated diphenyl ethers) in the food chain, and/or decreases in insect availability.

### **NEST-SITE SELECTION BY COOPER'S HAWKS (*ACCIPITER COOPERII*) ON MANAGED TIMBERLANDS IN THE COASTAL REDWOOD REGION OF NORTHERN CALIFORNIA**

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We examined nest-site selection by Cooper's Hawks on managed timberlands in the redwood region of north coastal California. Twenty-seven nests representing 14 nesting territories were located between 1999-2003 in redwood (*Sequoia sempervirens*)/Douglas-fir (*Pseudotsuga menziesii*) and Douglas-fir/hardwood habitat types. All nests were found in live trees, 57% in hardwood, 29% in Douglas- or grand fir (*Abies grandis*) and 14% in redwood. Redwood was used significantly less than expected. Cooper's Hawks selected nest trees in even-aged, mid-seral stage stands that contained significantly taller trees with shallower crowns than random plots. Nest stands also contained significantly more hardwoods

(>28 cm dbh) and had taller, less cluttered understories than random sites. Most nests were located in areas where tanoak (*Lithocarpus densiflora*) was the dominant component or comprised a large portion of the stand. Nest sites were also located significantly further from roads and closer to northern spotted owl (*Strix occidentalis caurina*) activity sites than random plots. The size of habitat buffers maintained around nests located within timber harvesting plans varied in size and are discussed in relation to productivity and reoccupancy in subsequent years.

## **RESOLVING RAPTOR ISSUES ON THE PATH 15 TRANSMISSION LINE PROJECT IN CALIFORNIA'S CENTRAL VALLEY**

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The Path 15 transmission line project connects the Los Banos Substation, near Santa Nella, California with the Gates Substation, near Coalinga, CA. Several Federally listed endangered or threatened species are known to or may occur in the vicinity of the transmission line. These include the San Joaquin kit fox (*Vulpes macrotis mutica*), which is known to occur in the project area and an experimental population of the California condor (*Gymnogyps californianus*), which is being established in the vicinity of the line. These two listed species presented special problems in that one is a raptor and the other is frequently hunted by raptors. Western altered the design of its transmission line structures in kit fox habitat to minimize raptor predation on the kit fox. Western also attached state-of-the art marking devices to the overhead ground wires to minimize condor collisions with the line. The paper will discuss the costs of design, changing structures, and adding anti-perching devices and line marking devices.

## **ECOLOGICAL CORRELATES OF SWAINSON'S HAWK (*BUTEO SWAINSONI*) NESTING SUCCESS IN THE BUTTE VALLEY, CALIFORNIA.**

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We studied Swainson's Hawks nesting in the Butte Valley, California, from 1992-2004. 175 individuals were color banded and nesting success was recorded. Through the course of the study, 484 nest attempts were found to produce 511 known offspring. Using SAS macros, we created a multiple linear regression model to compare nesting success with environmental variables. Variables used fell under three classifications: weather variables (e.g. number of days below freezing, monthly rainfall), spatial variables (e.g. distance from agriculture, nesting density of Swainson's hawks), and individual variables (e.g. age, number of years at the same territory). A preliminary regression model had an overall R-squared of 0.329 and was significant at the  $p < 0.05$  level. The analysis suggests that both distance of the nest from a road and the number of years a pair stays together have a significant positive relationship with breeding success ( $p$ -values 0.0011 and 0.0023, respectively). The distance of the nest from agriculture may have a slightly negative relationship with breeding success ( $p < 0.001$ ). Further analysis will be conducted to determine more subtle trends and verify those already established. These results support previous work on

this population suggesting a dependence on agriculture to maintain high hawk densities. This work also supports theories of experience enabling birds to produce a greater number of offspring and anecdotal accounts of the sensitivity of nesting Swainson's hawks.

### **STRANGERS IN A STRANGE LAND: LOWER APPARENT SURVIVAL RATES FOR HACKED THAN WILD-REARED APLOMADO FALCONS**

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The Northern Aplomado Falcon (*Falco femoralis septentrionalis*) has been the subject of a large-scale reintroduction effort conducted by The Peregrine Fund since 1993. Aplomado Falcon breeding pairs are now found in grassland habitats from Matagorda Island National Wildlife Refuge (NWR) in the Texas coastal bend to the lower Rio Grande valley of southern Texas and northern Tamaulipas, Mexico. The Peregrine Fund has continued to release captive-bred young in southern Texas using the "hacking" soft-release method, thus providing an opportunity to compare responses of wild-reared and hacked falcons to an environment containing older territorial falcons. Since 2002, intense monitoring in two study areas (centered on Matagorda Island NWR and Laguna Atascosa NWR) has identified approximately 38 breeding pairs and numerous non-territorial individuals, including 22 hacked and 44 wild-reared "young" falcons (hatched in 2001 or later). We compared apparent survival rates of young hacked and wild-reared falcons by means of an information-theoretic approach, using AICc (Akaike's information criterion corrected for small sample size) scores to evaluate models. The top model candidate, which was 4.5 times better supported than the next best-fit model, detected differences in apparent survival dependant on age class and falcon origin (wild-reared or hacked). The next best model indicated an additional sex effect. Model-averaged parameter estimates showed juvenile, hacked, and male falcons with lower apparent survival rates than adult, wild-reared, and female falcons, respectively. Given the potentially saturated environment of the study areas, the difference in apparent survival rates may represent differences in true survival, greater dispersal by hacked falcons, greater tolerance of wild-reared falcons by territory-holders in territory margins, or higher recruitment rates of wild-reared falcons into the breeding population.

### **MITOCHONDRIAL DNA ANALYSIS OF NORTHERN SPOTTED OWL (*STRIX OCCIDENTALIS CAURINA*) AND CALIFORNIA SPOTTED OWL (*STRIX OCCIDENTALIS OCCIDENTALIS*) POPULATIONS**

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Two subspecies of Spotted Owl (California and Northern) in four geographically distinct California populations were evaluated to determine the genetic structure within and among populations. DNA was obtained from molted or plucked feathers from at least 15 individuals from each coastal and inland population and the sequence of a 600 base pair region of the mitochondrial DNA control region determined. Unique haplotypes and different frequencies of shared haplotypes produced a distinct profile of genetic diversity for each population. The California Spotted Owl populations had substantially lower genetic diversity than the Northern Spotted Owl populations as indicated by the total number of haplotypes and nucleotide diversity. California and Northern Spotted Owl populations had very strong

genetic separation, with unique subspecies-specific haplotypes indicating limited gene flow. The populations within each subspecies also showed substantial genetic differentiation with the inland populations having more diversity than the coastal populations. The California Spotted Owl coastal population appears to have severely low genetic diversity, as all individuals had a single haplotype. Data will be compared to other mitochondrial DNA studies on Spotted Owls and to recent microsatellite analysis from our laboratory. The Northern Spotted Owl is currently listed as a threatened species under the U.S. Endangered Species Act. Our results provide baseline genetic information for these previously uncharacterized populations and suggest the California Spotted Owl be reevaluated for listing under the U.S. Endangered Species Act.

## **PLUMAGES OF BASIC II AND BASIC III LIGHT-MORPH ROUGH-LEGGED HAWKS**

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Adult Rough-legged Hawks (*Buteo lagopus*) are depicted and described in bird guides and handbooks as having sexually dimorphic plumages, however, several authorities have reported that they overlap in plumage by sex. We describe for the first time a Basic II plumage for this species, determined by incomplete flight feather molt, in which both sexes have female characters, and a Basic III plumage that is essentially adult, but shows a pale primary patch on the upperwings. We use the plumage and molt terminology of Howell et al (2003). Age was determined by primary molt: no molt for juveniles, one wave for Basic II, and two waves for Basic III. This was augmented by secondary molt. Basic III birds with male characters all had smaller wing chord measurements than those with female characters. The presence (males) or absence (females) of gray barring on the back feathers and flanks barred (males) or solid (females) were the best plumage indicators of the sex of adults and Basic III hawks. Undertail pattern was the most shared character and is not a reliable indicator of adult sex. We suggest that Basic II males that forego a breeding attempt increase their foraging skills and show higher reproductive success later.

## **FIRST KNOWN SPECIMEN OF A HYBRID *BUTEO*: SWAINSON'S HAWK X ROUGH-LEGGED HAWK FROM LOUISIANA**

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Hybrids have been reported for many species of birds, including a few cases between buzzards of the genus *Buteo* from Europe, Asia, and North America. Almost all of these are reports of hybrid pairs at the nest. Herein we report on a putative hybrid specimen between Swainson's Hawk (*B. swainsoni*) and Rough-legged Hawk (*B. lagopus*), which, to our knowledge, is the first hybrid specimen for the genus. It was collected in Louisiana in November 1994 as a Rough-legged Hawk and the specimen and a tissue sample were deposited in the LSU Museum collections. This specimen appeared somewhat different from the juvenile Rough-legged Hawks in this collection and was similar in plumage to a possible hybrid photographed by Martin Reid near Ft. Worth, Texas. Mt-dna determined that the mother was a Swainson's, however, nuclear dna was unable to determine the father. As the tarsi were feathered, the father is most likely either a Rough-legged or Ferruginous Hawk (*B. regalis*). The latter was eliminated by its larger feet, gape, and beak and plumage characters. Most of the characters of the hybrid were

intermediate between Swainson's and Rough-legged, but leg feather markings were not. The breeding range of Swainson's Hawk extends northward well into the open Taiga breeding habitat of the Rough-legged Hawk, albeit at a low density, which may be a factor in hybridization. Such hybrids, if they mate back with one of the parental species, would increase the genetic diversity of that species. In any case, such hybrids present field and museum identification problems.

### **ACCURACY ASSESSMENT OF ARGOS PTT LOCATIONS FOR TRACKING RED-TAILED HAWKS (*BUTEO JAMAICENSIS*)**

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Between 2000 and 2002 we obtained satellite location data from seven PTTs attached to the top of a stationary, two-meter-high pole (hereafter, test pole) placed in an open meadow (Kelly, Teton County, WY, 43.653N, 110.625W). We received a total of 4,259 test locations of which 1560 (37%) were of the high quality category. The median error of high quality locations was 1.5 km from the true location, with a maximum distance of 20.3 km. The median location error for all locations was 3.1 km with a maximum distance of 328 km. The distance between the centroid for the high quality category and the true location of the PTTs was 85 m and 212 m for all locations. The fact that the Red-tailed Hawk maintains a relatively small use area while nesting, wanders over a large area if not nesting and, makes migrations in excess of 4,000 km makes it an excellent species to evaluate the effects of satellite derived location error at three geographical scales. We estimated a MCP (ArcView extension HOME) use area for a nesting and non-nesting Red-tail Hawk and the fall/spring migration of 21 Red-tails. Comparing 499 satellite locations of a nesting Red-tailed Hawk obtained concurrently with 300 hrs visual observations, we demonstrate that home range estimators overstated the use area as observed on the ground. We found that satellite location error resulted in an overestimation of 14-244 percent of large use areas of non-nesting Red-tailed Hawks and can be a source of error in estimations of long range migrations.

### **ALLOMETRY OF ALARM CALLS: BLACK-CAPPED CHICKADEES (*POECILE ATRICAPILLA*) ENCODE INFORMATION ABOUT RAPTOR SIZE IN THEIR MOBBING CALLS**

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Many animals produce alarm signals when they perceive a potential predator. Although there has been intense interest in the function and the evolution of alarm calls, we still know very little about the type or amount of information contained in these important signals. Here we demonstrate that subtle variations in the mobbing alarm calls of black-capped chickadees contain a previously unsuspected amount of information. We presented 15 different species of live, perched raptors and mammals to flocks of Black-capped Chickadees in experimental aviaries. Analyses of recordings show that chickadees encode predator-specific information in their mobbing alarm. Acoustic features of the "chick-a-dee" mobbing call varied predictably with the body size of the predator, providing the first evidence of an allometric relationship with alarm calls. Companion playback experiments reveal that receivers detect this

information and that the intensity of their behavioral response is correlated with the size of the potential predator. This study demonstrates an unsuspected level of complexity and sophistication in avian alarm vocalisations.

### **A HABITAT PREDICTABILITY MODEL FOR GOLDEN EAGLES (*AQUILA CHRYSAETOS*) ON PRIVATE TIMBERLANDS IN COASTAL NORTHERN CALIFORNIA**

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Distribution and habitat use of Golden Eagles is poorly understood on the North Coast of California, but it is known that Golden Eagles need large amounts of open land to forage and ensure reproductive success. The historical rarity of Golden Eagles in North Coastal California may be linked to the lack of foraging habitat. Given this uncertainty, State agency biologists have requested extensive surveys for this species on 88,087 hectares of coastal redwood and Douglas fir stands, and prairies owned by PALCO. Beginning in 2002, we conducted extensive surveys for Golden Eagle nests. Prior to these surveys, only 2 nests were recorded in Humboldt County, CA. We located an additional 12 historic, active, or occupied nests. Additionally, these surveys documented large areas with no eagle sightings, suggesting that large portions of PALCO's forested lands may be unsuitable habitat for nesting eagles. To better understand Golden Eagle habitat use in North Coastal California, we examined the habitat characteristics surrounding the nests of this species at the landscape scale using Geographic Information System technology. We found a strong and consistent pattern in the abundance of foraging habitat located within a 3-km radius core area around known Golden Eagle nests. We also found that sites with the most foraging habitat were more likely to have nesting eagles. With this information, our land managers are developing a more cost effective and refined protection strategy for Golden Eagles in North Coastal California.

### **MONITORING MOVEMENTS AND FORAGING OF BALD EAGLES (*HALIAEETUS LEUCOCEPHALUS*) REINTRODUCED ON THE NORTHERN CHANNEL ISLANDS, CALIFORNIA USING SOLAR ARGOS/GPS PTTs AND VHF TELEMETRY**

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Bald eagle populations on the California Channel Islands disappeared by the 1960's, primarily because of DDT pollution. Since 1980, bald eagles have been reintroduced on the southern Channel Islands but successful reproduction is still precluded by DDE contamination, a metabolite of DDT. In 2002, we began a five-year experimental bald eagle restoration effort on the northern Channel Islands in the hopes that these islands are far enough from the major DDE contamination to allow successful future reproduction. To date, twenty-five eagles have been equipped with backpack-mounted VHF and satellite transmitters, patagial tags, and federal leg bands, and have been released on Santa Cruz Island through the hacking technique. The transmitters allow us to monitor and plot the overall movements of the eagles and track the eagles to specific locations for direct observations. Of particular concern were the foraging activity of the eagles and their potential use of sensitive marine bird species breeding on the islands and potentially DDE-contaminated items, such as marine mammal carcasses. The satellite data show that the eagles regularly move among the four northern Channel Islands and do not appear to concentrate activity

around breeding colonies of sensitive marine bird species. By analyzing satellite data for areas of increased eagle activity and then using VHF telemetry and patagial tag identifications to track eagles to specific foraging locations we have observed eagles feeding on carcasses of feral pig (*Sus scrofa*), mule deer (*Odocoileus hemionus*), elk (*Cervus elaphus*), and marine mammals. Continued intensive monitoring and future analyses of known food items will allow us to evaluate potential contaminant loads incurred by the eagles and help guide future management strategies.

## **ANNUAL DISPERSAL OF BURROWING OWLS (*ATHENE CUNICULARIA*) IN THE NORTHERN GREAT PLAINS**

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One of the factors implicated in the Burrowing Owl's (*Athene cunicularia*) decline is its apparent low recruitment. Return rates for banded birds are about 6% for hatch year owls and 30% for breeding owls. However banding studies are limited by the ability of observers to detect bands particularly away from their study sites. Stable-isotope analysis provides a new technique to investigate annual dispersal. We compared the stable-isotope signature of feathers collected from breeding adults to those collected from nestlings across western North America. Annual breeding dispersal distance for owls was approximately 400km indicating that many owls are dispersing beyond the boundaries of study areas where owls are banded. Our comparison of the origin of owls breeding in the Canadian Great Plains with those in adjacent northern states indicates that net emigration of owls from Canada approximates the decline of the Canadian population. The implications of these findings on burrowing owl conservation will be discussed.

## **MITIGATING RAPTOR ELECTROCUTION IN TUCSON, ARIZONA**

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In 2003 and 2004 we monitored power poles within 500 meters of Harris' Hawk (*Parabuteo unicinctus*) nests in urban Tucson, Arizona to assess rates of electrocution before (2003) and after (2004) installation of raptor protective hardware. In the first year of the study, we documented a rate of 1.3 electrocutions per nest. In the second year that rate was reduced to 0.3 electrocutions per nest. Of the electrocutions that occurred on retrofitted poles, none were found to be due to equipment failure. Rather, the 0.3 incident rate occurred on unprotected poles that were overlooked during the retrofitting process, or on unprotected portions of partially retrofitted poles. These data indicate that raptor protective devices are effective at preventing most electrocutions when they are installed over all dangerous points on all dangerous poles within the natal territory. We also found that if even a single dangerous configuration remains within the natal territory, one of the resident raptors at that nest is likely to encounter it eventually, and to be electrocuted. Our findings support previous conclusions that rates of electrocution are higher for fledglings, and for female hawks, but strongly refute the assertion that most raptor electrocutions result in power outages. Finally, we found that 41% of wild female Harris' Hawks trapped for banding in our study area presented either confirmed or suspected electric shock injuries. These persistent injuries likely lead to electrogenic handicaps which reduce the survival and fecundity of affected birds. If this pattern exists globally, as electrocution mortality data suggests, then biologists could be over-estimating the effective populations of many raptor species world-wide.

**ROADSIDE RAPTOR, LOGGERHEAD SHRIKE (*LANIUS LUDOVICIANUS*) AND COMMON RAVEN (*CORVUS CORAX*) SURVEYS IN THE CARRIZO PLAIN NATIONAL MONUMENT, SAN LUIS OBISPO COUNTY, CALIFORNIA**

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I conducted 70 roadside surveys in portions of the valley floor of the Carrizo Plain National Monument (CPNM) monthly from September to April. The surveys started in 1990 and ended in 1995. The two routes were 40.2 km and 43.5 km long and each was 1.6 km wide, 0.8 km on each side of the road. Each raptor, Common Raven or Loggerhead Shrike was identified, approximate location mapped, activity and habitat use noted, and aged and sexed if possible. Differences in habitat and bird species composition were noted between the routes, one along portions of Soda Lake Road and the other along portions of Elkhorn Road. Numbers of birds detected varied drastically between years, regardless of the route. Much of the change in numbers was apparently in response to the cessation of drought and the subsequent recovery of annual vegetation and prey populations. Combined, one species of Cathartidae, 11 species of Falconiformes and two species of Strigidae, in addition to the raven and shrike, were detected along the routes. Common Ravens were the most commonly recorded species followed by Loggerhead Shrike and Red-tailed Hawk. Bird activity at first detection, and perch strata type and height varied widely between species. Some species opportunistically utilized available human-made perch strata at a much higher rate than others. Management implications are discussed.

**NEST SITE CHARACTERISTICS AND PRODUCTIVITY OF PEREGRINE FALCONS (*FALCO PEREGRINUS*) IN SOUTHERN ONTARIO**

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In 1995, two Peregrine Falcon pairs nested in southern Ontario, marking the first successful breeding in the region in over thirty years. Since then, 18 sites have been used, including a one-year high of 10 active nests in 2004. From 1995 to 2004, 217 eggs were documented at 63 nesting attempts. The overall hatching rate was 65.9%, with higher success at southwest, south, or southeast facing nests (76.8%, n=28) than at others (56.8%, n=35). Two-thirds of nesting attempts were at sites with full overhead cover; hatching success at these averaged 76.6% versus 44.4% at sites with partial or zero cover. Of all chicks hatched (n=143), 95.8% survived to fledging, and 78.3% survived to independence. To supplement natural productivity, 49 juveniles were hack released at 15 sites between 1999 and 2004. Government biologists and/or experienced volunteers monitored all nests and releases. Fledglings were rescued whenever injured, or at risk of injury from ground predators and/or traffic. Only 8.2% of hack released peregrines were rescued, compared to 41.6% of wild hatched juveniles. Of young hatched between 1995 and 2003, the fate, one year post-fledging, is known for 43.7% (n=119) of wild hatched and 42.2% (n=45) of hack released birds. First year mortality was 63.5% for wild hatched individuals and 68.4% for hack released birds. Of the survivors, 15 wild hatched individuals have produced 101 offspring, while the only breeding hack released bird has produced five. Two of the breeders displaced one of their parents from their natal sites, two took over existing Ontario territories, five established new territories in southern Ontario, and the remaining seven nested in Michigan, Ohio, or New York. These results from Ontario

suggest that a broader review of the eastern Peregrine Falcon population could reveal important patterns to better guide future management efforts.

### **THE FLIGHT PATTERNS OF RED-TAILED HAWKS (*BUTEO JAMAICENSIS*) IN LANDSCAPES FRAGMENTED BY AGRICULTURE**

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Every year, the U.S. Air Force (USAF) spends millions of dollars repairing damage to aircraft caused by over 2700 collisions with birds of various species. Red-tailed Hawks are involved with 14% of all bird strikes. My objectives were to build predictive models for Red-tailed Hawk flight altitude; thereby, providing information to improve the USAF Bird Avoidance Models. During 1999-2003, I recorded 4946 observations on 10 radio-marked Red-tailed Hawks in north-central Indiana. Marked Red-tailed Hawks were tracked for 4-hr intervals using instantaneous sampling. The flight altitude of the focal individual was recorded every 15 min, as were data on site-specific weather conditions. Red-tailed Hawks tended to increase their flight altitude as temperatures increased and as relative humidity decreased. In January, February, April, November, and December they spent more time at altitudes <92 m altitude compared to other times of the yr, whereas in May they spent more time ≥92 m. In early mornings and evenings, Red-tailed Hawks tended to perch and rarely flew ≥92 m altitude, whereas in mid-day hawks more frequently flew at high altitudes and infrequently perched. Red-tailed Hawks rarely flew during periods of 100% cloud cover and instead used low altitude flight or perching behaviors; during periods of no cloud cover, they flew at ≥92 m altitude more than in any other conditions and avoided perching. I did not observe any flight above 31 m altitude in conditions of precipitation. Red-tailed Hawks selected perching behaviors in forested areas, pastures, and grasslands. However, while in plowed agricultural fields or in agricultural fields with young crops, hawks were more likely to soar ≥92 m altitude. Binomial logistic regression and Akaike Information Criterion were used to create and evaluate models of Red-tailed Hawk flight altitude based on temporal, spatial, and weather variables.

### **PREHISTORIC HUNTING OF CALIFORNIA CONDORS (*GYMNOGYPS CALIFORNIANUS*) AND BALD EAGLES (*HALIAEETUS LEUCOCEPHALUS*) ON THE COLUMBIA RIVER**

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The Fivemile Rapids (35WS8/WS4) archaeological site is located on the Columbia River, near the present day city of The Dalles, Oregon, and was excavated from 1952 through 1956, in preparation for construction of The Dalles Dam. The site is renowned for its vast Early Holocene salmonid deposit of cultural origin. The Fivemile Rapids site also contained over 9,000 bird remains, including California Condor, Bald Eagle, cormorants (*Phalacrocorax* sp.) and gulls (*Larus* sp.) dating between 11,000 and 7,000 years B.P. The presence of raptor and scavenger bird remains has been used as evidence that the bird bones accumulated naturally and that Fivemile Rapids was a “condor cafeteria” where condors fed on the remains of human-procured salmon. Continuing debate necessitated a reinvestigation of the avifaunal collection. This analysis has revealed extensive evidence of cultural modification on the bird remains. 328 remains display cut and chop marks, three represent artifact manufacturing debris, and 691 are limb bone cylinders. Two distinct patterns of butchery are present. Raptor butchery focused on

feather harvesting, talon removal, and artifact manufacture, whereas gulls and cormorants were butchered for consumption. Skeletal part frequency analysis further suggests that humans were the primary agent of accumulation. Water birds but not raptors have a significant skew toward distal wing elements. This study demonstrates that birds were a valuable resource for the people at The Dalles and that California Condors and Bald Eagles were the target of human hunters on the Columbia River for thousands of years.

## **AVIAN PROTECTION PLANS AND NATIONAL WILDLIFE REFUGES**

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The U.S. Fish and Wildlife Service (FWS) initiated a survey in 2003 to determine if power lines on National Wildlife Refuges (NWRs) in Region 6 were causing either bird electrocutions or collisions. The FWS subsequently identified six NWRs in need of power line field inspections in order to identify problem poles/spans for retrofitting. Power lines on Red Rock Lakes, Lee Metcalf, North Platte, Fish Springs, Lostwood, and Seedska-dee NWRs were subsequently inspected. These surveys were in tandem with a much larger retrofitting effort in Region 6. In 2002, Colorado became the first state to implement a holistic coordinated effort to reduce power line bird electrocutions. Between January 2002 and December 2003, 21 electric cooperatives, two municipal utilities, and Public Service of Colorado (Xcel Energy) joined forces to develop statewide Avian Protection Plans, which included proactive retrofitting. The process included developing GIS-based bird use and concentration areas, overlaying existing power line information, and identifying potential risk areas within each utility service territory. Power lines in high-risk areas were then field inspected, and retrofits were identified and prioritized. Although the same approach was used for the FWS refuge surveys, the refuges were examined more in depth, given their smaller size. The NWR inspections resulted in a parallel product in that risk evaluations for existing structures were developed based on pole configuration, aspect, terrain, habitats, and known bird use. Carcasses detected on the refuges included three eagles, five hawks, three owls, five ravens, and one sandhill crane. A total of 365 structures were identified for electrocution/collision retrofitting. A matrix was developed providing detailed information for both short- and long-term structure retrofitting. This included a list of retrofitting items and a retrofitting prioritization based upon habitat and pole configurations. In addition, new construction approaches and design recommendations were provided to minimize future problems.

## **GOSHAWKS (*ACCIPITER GENTILIS*) PASSING THROUGH DULUTH, MINNESOTA: FROM TWO DISTINCT LOCATIONS?**

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The migrational and dispersal movements of Goshawks within North America are poorly understood. However, long-term trends from migration stations indicate that irruptions of goshawks occur at about 10-year intervals, especially within the western Great Lakes region. Hawk Ridge Nature Reserve in Duluth, Minnesota, is the leading migration station in North America that records these trends. We collected feathers during fall migration from Goshawks for two years, 2001 and 2002, to assess whether hydrogen isotopes could be used to determine latitudinal origins of the birds. Feather samples were also solicited

from persons working with nesting Goshawks throughout northwestern North America to evaluate isotope values from birds of known location. Feathers from a total of 122 hatch-year Goshawks captured at Duluth showed a distinct bimodal distribution. The primary mode (n = 52) appears to describe a local pattern of dispersal and the other mode (n = 22) describes birds from further north. These results were consistent for both males and females and for both years the feathers were collected.

### **DNA ANALYSIS OF NATURALLY MOLTED FEATHERS FOR EXPANDED RAPTOR MONITORING WITH EXAMPLES FROM SPOTTED OWLS (*STRIX OCCIDENTALIS*)**

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Molted feathers can easily be collected from core roost or nest areas of territorial avian species and, in combination with DNA analysis, may provide estimations of site fidelity, reproductive status, relationships of all sampled individuals at a site, floater status, and the identity of remains. Applications of forensic DNA feather analysis will be discussed using specific examples from recent Spotted Owl research. Every owl sampled for population genetic analysis ( $N = 153$ ) displayed a population unique fingerprint at six microsatellite loci. In populations with reduced genetic variability all owls were differentiated at as few as four microsatellite loci. Feathers collected from the ground at historical spotted owl territories confirmed seasonal reproduction (without nesting surveys) by analysis of juvenile vs. parental alleles. Feather sampling also suggested that additional unrelated owls (floaters) were present at nesting and roosting areas of established territorial pairs. Feathers collected in different years from the same owl territory and roosting area provided identical microsatellite fingerprints in multiple years, suggesting site fidelity. The genetic relationship of salvaged owls to other family members at pair territories was determined. The advantages and disadvantages of non-invasive sampling and the use of molted feathers for genetic analysis will also be addressed. A combination of microsatellite fingerprinting, DNA sexing, and mitochondrial DNA control region sequencing of molted feathers from nest areas over time could be used in select populations (in addition to demographic monitoring or alone) to assess genetic and site occupancy characteristics not available through traditional monitoring methods.

### **THE CONSERVATION OF THE WESTERN BURROWING OWL (*ATHENE CUNICULARIA HYPUGAEA*)**

**GEOFF HOLROYD, JASON DUXBURY and HELEN TREFRY**, Canadian Wildlife Service, Room 200, 4999-98 Ave., Edmonton, AB, T6B 2X3, Canada.

In Canada, the western Burrowing Owl (*Athene cunicularia hypugaea*) is endangered and its numbers are rapidly declining. There are less than 1000 pairs left in Canada and the number of breeding pairs is declining at about 22% per year even though over 700 landowners are voluntarily protecting over 37,000 hectares of grassland habitat that was used by nesting owls. Burrowing Owl populations are also in decline in other parts of western North America. With support from the Commission on Environmental Cooperation, we have drafted a Conservation Action Plan for review by the Burrowing Owl conservation community. In this presentation we will highlight key elements of the plan, solicit reviews, and discuss the future of cooperation for the burrowing owl in Mexico, USA and Canada. The draft plan will be available from [geoffrey.holroyd@ec.gc.ca](mailto:geoffrey.holroyd@ec.gc.ca) after 15 September 2004.

**OBSERVATIONS OF ARBOREAL FORAGING IN MIGRANT SWAINSON'S HAWKS  
(*BUTEO SWAINSONI*): A NEW ALTERNATIVE HYPOTHESIS TO THE FASTING  
MIGRATION MODEL**

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The bioenergetic question of how Swainson's Hawks accomplish their semiannual trek between North America and South America has remained unanswered for many decades. Proponents of the fasting migration hypothesis contend that the 9000 km, 5-week journey could largely be fueled by using stored body fat deposited before the main migration. Others have objected that such large fat stores (55% of lean body mass) have not been documented in any raptor species and are physiologically unlikely. In recent years, some anecdotal observations of migrant Swainson's Hawks feeding on the wing as well as on the ground appear to support the notion that these hawks sometimes are willing to feed opportunistically. However, careful observations of the behavior of migrant Swainson's Hawks in their roosting trees in coastal Chiapas, Mexico during October 2003, has provided new evidence of a third feeding alternative, namely arboreal foraging, a behavior not previously described in migrant buteos. A description of the evidence for arboreal foraging behavior, as well as the bioenergetic ramifications of this discovery and its possible utility in resolving this puzzling question will be the primary focus of this presentation.

**RESPONSE OF NESTING PRAIRIE FALCONS AND GOLDEN EAGLES TO LOSS OF  
SHRUB HABITATS IN THE SNAKE RIVER BIRDS OF PREY NATIONAL  
CONSERVATION AREA**

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Wildfires, livestock grazing, military training activities, and drought have interacted to cause extensive habitat changes in the Snake River Birds of Prey National Conservation Area (NCA). Many have hypothesized that shrub loss will cause declines in prey and raptor populations, and data from 1990 to 1997 suggested that the number of Prairie Falcon and Golden Eagle pairs had declined. In 2002 and 2003, we re-assessed the abundance and productivity of falcons and eagles in the NCA to determine if long-term declines had occurred. Of 40 historical territories in the NCA, Golden Eagles occupied 30 and 29 in 2002 and 2003 respectively. The decline in number of occupied eagle nesting territories, combined with the apparent decline in black-tailed jackrabbits (the eagle's major prey) suggests a reduced carrying capacity for Golden Eagles in the NCA. Neighboring pairs subsumed 4 of 6 territories vacant for  $\geq 15$  consecutive years. Eagle productivity has shown no significant trend over time. Our observations suggest that the less productive territories in the NCA became vacant and that a core of pairs in productive territories produced most young for the population. The number of Prairie Falcon pairs in the NCA was higher in 2002 than in any previous year (217), and although the estimated number of pairs declined to 204 in 2003, confidence intervals were too wide to determine if the decline was statistically significant. Falcon productivity in 2003 was lower than in any years except 1982 and 1993. Changes in falcon abundance and productivity seem to reflect changes in ground squirrel abundance. Piute ground squirrel populations show more variability in altered exotic annual grass communities than in native shrub habitats. It is likely that habitat and climatic changes have resulted in greater year-to-year fluctuations in falcon abundance and productivity.

**RESPONSE OF AVIAN PREDATORS TO THE DEVELOPMENT OF A HIGH VOLTAGE ELECTRIC TRANSMISSION LINE IN NORTHEASTERN NEVADA**

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The development of overhead utility lines can change the distribution of avian predators by providing hunting perches for birds such as Golden Eagles (*Aquila chrysaetos*) and Common Ravens (*Corvus corax*), which have been implicated in Sage Grouse (*Centrocercus urophasianus*) declines. We monitored the response of raptors and corvids to the construction of a 286 km, 345 kilovolt transmission line near active Sage Grouse leks in northeastern Nevada. Our objectives were to: 1) measure the effectiveness of anti-perching devices installed on transmission line towers in reducing and/or preventing perching by avian predators; and 2) measure the effects of the transmission line on the distribution and relative abundance of avian predators. We conducted weekly transect surveys along three study routes and a control route from February-July 2003 and 2004. Of 14 species of potential avian predators counted, 73% were Common Ravens. The most abundant raptors observed at the study routes were American Kestrels (*Falco sparverius*) (14.4%), Golden Eagles (6.7%), and Ferruginous Hawks (*Buteo regalis*) (2.5%). At the control route, the most abundant raptors were Golden Eagles (6.3%), American kestrels (3.9%), and Prairie Falcons (*Falco mexicanus*) (3.6%). While more Golden Eagles were observed away from the transmission line corridor (>0.4 km), both before and after construction, a greater proportion was seen within 0.4 km of the transmission line after construction on all study transects. Perch deterrents were partially effective, as the number of eagles seen perching on them declined gradually during 2004. The average time spent perching on a deterrent for large raptors was 18 min (range: 30 sec-70 min [n=34]); the average time perching on other substrates was 38 min (range: 24-125 min [n=9]).

**STUDY DESIGN ISSUES IN RAPTOR ELECTROCUTION RESEARCH--A REVIEW**

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We reviewed the raptor electrocution literature worldwide to assess what is known about the subject with reasonable certainty and to assess current information needs. Specifically, we wondered if there was evidence that three decades of effort to reduce raptor electrocutions has had positive effects. We searched peer-reviewed journals, symposia proceedings, other published sources, and some unpublished work (e.g., theses and dissertations), emphasizing original research published in English. Nearly all of the literature we examined (>125 articles) came from North America, Western Europe, and South Africa. In spite of intensive and often sustained effort by the governments and suppliers of electricity across the three regions, in 2004 it cannot be said with certainty that the incidence of electrocution has fallen since mitigation programs began three decades ago--except in those European countries where medium voltage distribution lines have been placed underground. Reliable estimates of electrocution mortality, including numbers of birds killed and rate estimates for different pole designs, are with very rare exception unavailable. Data that have been analyzed are almost certainly biased, but to unknown degrees. At this time, few researchers have demonstrated the reliability of standardized retrofitting procedures or the effectiveness of specific sampling techniques or approaches to monitoring. Progress in alleviating a greater portion of electrocution mortality than apparently has been achieved to date has been hindered by the sheer scale of the problem, ad hoc (per pole) approaches to mitigation (as opposed to treatment at

landscape levels), and a general lack of commitment to scientific rigor in most research on raptor electrocution. Future progress in reducing raptor electrocution mortality will require prospective sampling designs that generate rate estimates of mortality, address biasing factors, and include predictions concerning risk, and techniques to reduce risk, that can be tested in the field or laboratory.

## **INSTANCES OF APPARENT PREY SPECIALIZATION BY GALÁPAGOS HAWKS ENGAGED IN REARING YOUNG**

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Inherent to optimal foraging theory is the idea that predators will concentrate their efforts on those prey items that are most energetically profitable. Compatible with this theory is the concept of “search image,” wherein a predator will concentrate its hunting efforts on prey that it has become very adept at recognizing and processing. These behavioral specializations decrease the handling costs and time, thereby increasing the profitability of the target prey. Having become easily spotted and efficiently processed, this target prey becomes energetically optimal for the foraging predator to focus its efforts on (regardless of its abundance, or lack thereof), potentially leading to prey specialization. During the years 2001-2003, we observed 20 nests attended by uniquely-marked Galápagos Hawks (*Buteo galapagoensis*) for 1065 hr. For the purposes of this paper, only prey deliveries made by males were included because females will occasionally take prey from males, thus, making it unclear exactly which bird caught the item. Marked males made more than 800 deliveries of 11 types of prey. In several cases, we observed that individual males specialized in taking certain types of prey between years. As the abundance of different prey types varied substantially between years, our results supported the concept of individual prey specialization by male Galápagos Hawks independent of prey availability. Such individual specialization could be adaptive by reducing competition for prey with neighboring conspecifics and among members of the same territorial group.

## **SELECTION OF FORAGING AND SINGING HABITAT BY FLAMMULATED OWLS (*OTUS FLAMMEOLUS*) IN COLORADO**

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As part of a long-term investigation of habitat and demography in Flammulated Owls in Colorado, we studied selection of habitat by breeding males for foraging and singing in a mixed conifer forest from 1982-83 and 2003-04. We compared characteristics of trees used for foraging ( $n = 78$ ) and singing ( $n = 97$ ) with available trees within owl territories, based on observations of radio-tagged males ( $n = 7$ ) and singing males ( $n = 23$ ). Males, which are insectivorous and feed mostly on lepidopterans (moths), foraged primarily in the crowns of ponderosa pine (*Pinus ponderosa*) and Douglas-fir (*Pseudotsuga menziesii*). Compared to available trees, trees used for foraging had a larger mean diameter-at-breast-height (dbh;  $38 \pm 1$  cm vs  $24 \pm 1$  cm;  $P < 0.001$ ), greater mean crown volume ( $180 \pm 15$  m<sup>3</sup> vs  $47 \pm 7$  m<sup>3</sup>;  $P < 0.001$ ),

and had greater mean age ( $208 \pm 11$  yr vs  $113 \pm 10$  yr;  $P < 0.001$ ). Compared to available trees, trees used for singing also had larger mean dbh ( $46 \pm 2$  cm vs  $24 \pm 1$  cm;  $P < 0.001$ ), greater mean crown volume ( $210 \pm 32$  m<sup>3</sup> vs  $47 \pm 7$  m<sup>3</sup>;  $P < 0.001$ ), and had greater mean age ( $304 \pm 29$  yr vs  $113 \pm 10$  yr;  $P < 0.001$ ). These data show that breeding male Flammulated Owls selectively foraged and sang from relatively large trees, whose open, voluminous crowns facilitated the search and capture of crown-based prey, and probably provided protection from predators when engaged in territorial song. These data also help provide a behavioral context for understanding the basis of the finding that owl productivity was positively correlated with area in ponderosa pine/Douglas-fir forests in territories from 1981-1999. Study is needed in other forest types and in other portions of the owl's range to determine the generality of our findings.

## **ELECTRICAL ASPECTS OF A CHANGING ENVIRONMENT**

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The geographical location of the power line is of utmost importance. A “barren” piece of land may be home to multiple prey species such as lizards, mice, squirrels etc. Placing a pole line through this area now provides perching and nesting habitat. Man made lakes, ponds or irrigation canals provide a water source. Once what was barren land may now invite raptors to the area. As the environment changes the prey species may change, drawing larger raptors to frequent the area. It is of utmost importance to evaluate the existing power lines for proper spacing and configuration of conductors suitable for the large raptors. In areas with heavy waterfowl migration or flight paths, electrical lines may need altering in placement and design to prevent wire strike or collision. Improper construction of power lines may result in unplanned outages and injuries to wildlife. In general, collision with electric conductors is not a problem with raptors. In most instances a bird caused outage is not the result of a wire strike, but the result of the bird becoming a conductor between the two wires (conductors) resulting in electrocution. A consciences developer altering the landscape should develop a proactive plan to address the above issues and work in conjunction with the utility company ultimately responsible for the power lines. All wildlife refuges should have only raptor safe power lines. Retrofitting all power lines within wildlife sensitive areas should be considered. All power lines, whether privately owned or owned by a utility company, are subject to the penalties put forth by the Migratory Bird Treaty Act and the Endangered Species Act, when protected wildlife becomes injured.

## **RAPTOR ELECTROCUTION: CAUSES AND PREVENTIONS**

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Nationally and internationally avian species, particularly raptors, are threatened by electrocution from power lines and electrical equipment. The common factor for any electrocution is when the bird makes two points of contact. Phase to phase electrocutions are most deadly, as the current will travel through vital organs at the full line voltage. Phase to ground is less serious as roughly half the line voltage will usually travel down the side of the body (from a wing out a foot). Environmental factors enhancing the bird's conductivity include moisture such as rain or fog and soil or dirt clinging to the feathers. Removing one point of contact by insulating or isolating the electrical equipment will remove one of the

factors necessary for electrocution, thus decreasing the possibility of bird electrocutions. Sixty-inch phase separation (isolation) of the electrical lines, placing perch deterrents, replacing the cross-arms with a non-conductive material and insulation of the center phase will prevent electrocution. Apparatus poles, such as those with a transformer, are more likely to result in electrocution of the birds. This is due to the placement of the wires on the top of the transformer. These poles require more detailed insulation to remove the possibility of electrocution. Plans to utilize raptor construction in the future will help reduce bird caused outages and help save wildlife.

### **SHORT AND SWEET: THE POST-FLEDGING DEPENDENCE PERIOD OF GOLDEN EAGLES (*AQUILA CHRYSAETOS*) IN DENALI NATIONAL PARK AND PRESERVE, ALASKA**

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The post fledging dependence period is one of the most important, yet least studied, parts of a raptor's life. For fledglings of many raptor species, the post-fledging dependence period is important for acquiring adequate food reserves before migration, improving flight skills, or developing hunting skills. The post-fledging dependence period also may be a time when fledglings can learn the essential skills for survival without the additional pressures of having to secure food. Despite the importance of this time, there are very few published accounts on the length of the post-fledging dependence period for Golden Eagles across their Holarctic range. We calculated the duration of the post-fledging dependence period and estimated survival during this period for migratory Golden Eagles using satellite telemetry over three consecutive years, 1997-1999. The post-fledging dependence period averaged 49.8 days (SD = 6.1 days, n = 41). The post-fledging dependence period was longer for eagles that hatched earlier, although hatch date did not influence date of departure from the natal nesting territory. Fledgling Golden Eagles departed their natal areas over a 3-week period from 17 Sept. to 5 Oct. (mean = 26 Sept., SD = 4.9 days), 32 to 62 days after fledging. Siblings usually departed their natal areas >2 days apart. The post-fledging dependence period of migratory Golden Eagles in Denali is shorter than those reported for non-migratory populations of this species. The estimated survival rate during the fledging dependence period was 0.98 (95% C.I. = 0.92 to 1.00, n = 45). Survival did not differ between males and females ( $P = 0.45$ ) or between fledglings from nesting territories with low and high reproductive histories ( $P = 0.13$ ).

### **SHORT-TERM EFFECTS OF TIMBER HARVEST ON NORTHERN GOSHAWK (*ACCIPITER GENTILIS*) BREEDING AREA OCCUPANCY, NEST SUCCESS, AND PRODUCTIVITY**

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We studied 18 goshawk territories in northern Idaho to determine the short-term effects of timber harvest on Goshawk breeding area occupancy, nest success and productivity. We defined breeding areas as the 170 ha area surrounding one or more goshawk nests. Harvested breeding areas ( $n = 9$ ) were those that were subjected to a minimum of 11% (range 11-38%) of the breeding area disturbed by timber harvest

(50-99% overstory removal within harvest boundary), and were compared to non-harvested controls ( $n = 9$ ). Breeding areas were harvested in 2002 ( $n = 4$ ) and 2003 ( $n = 5$ ), and monitored along with controls through 2004. All breeding areas successfully fledged young the yr prior to treatment, and productivity (0 = 2.0 fledglings per nest) was the same between treatments prior to timber harvest. Timber harvest had no effect on breeding area occupancy, nest success, or productivity 1-2 yr post-treatment ( $P > 0.500$ ). Occupancy of harvested breeding areas was 89% and 75% after 1 yr and 2 yr, respectively, compared to 80% and 78% of controls after 1 yr and 2 yr, respectively. Nest success and productivity were influenced by spring weather rather than timber harvest. Mean distance from old nest to new nest within breeding areas was 350 m for treated areas and 257 m for control areas, and did not differ ( $P = 0.215$ ). In northern Idaho, timber harvest does not appear to affect Goshawk breeding area occupancy, nest success, or productivity 2 yr after harvest as long as suitable nesting habitat remains within the breeding area. We will continue to study these breeding areas to determine the long-term effects of timber harvesting on breeding Goshawks in this region.

## **HARPY EAGLE DIET AND PREY DELIVERY IN ECUADOR**

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The Harpy Eagle (*Harpia harpyja*, Linneo 1758) is considered the most powerful bird of prey of the world, as well as one of the largest. It formerly inhabited tropical and subtropical rainforest to about 900 m from southern Mexico to northern Argentina. In Central America its population is highly fragmented and only in Panama seems to be more continuous. In Ecuador, its distribution is restricted to several reduced patches of forest at the northwest of the country and more homogeneously below 400 m a.s.l. in the East, where Ecuadorian Amazon Basin starts. The Harpy Eagle is currently considered near-threatened throughout its range. In Ecuador it is believed to be an endangered species. In 2002, the Harpy Eagle was appointed “The bird that represents all the Ecuadorian biodiversity”, and there is a program to protect it. The first Harpy Eagle active nest to be monitored in Ecuador was found in 2002 in the northeast. Since then, five additional nests were been found but only three of them were monitored to collect data about behaviour, diet and ecological requirements. There are published records about diet or predatory attempts of this species but no reports have been published of Harpy Eagle predation or diet for Ecuador. This communication is part of the Harpy Eagle Research and Conservation Program in Ecuador. Here I present the first diet analysis of four juveniles and one adult of Harpy Eagle found in the northeast of Ecuador. Additionally, I present the first record of a harpy eagle nest and diet west of the Andean Mountains. Observed deliveries and collecting prey bones beneath the nest tree served to assess the number and species of the prey delivered. It was taken into account that prey conservation status also would affect their predator.

**AN EVALUATION OF SOLAR-POWERED GPS TRANSCEIVERS USED TO MONITOR CALIFORNIA CONDOR (*GYMNOGYPS CALIFORNIANUS*) MOVEMENT**

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We initiated a study to evaluate the performance of a lightweight (50g), solar-powered GPS transceiver to monitor California Condor movements in central and southern California and report our preliminary findings. Transceiver duty cycles were programmed to gather location data once per hour, for 16 hours on a daily basis. Prior to attaching the units to Condors six transceivers gathered location data at fixed, known locations. We found a significant difference with respect to the accuracy of the locations yielded by the transceivers ( $P = 0.000$ ) with average distances from known locations ranging between 10.1 and 23.6 m. Upon attachment to free-flying condors we evaluated the number of location fixes received on a daily basis and found a significant difference among seven transceivers ( $P = 0.001$ ) with the average number of location fixes yielded per day ranging between 10.0 and 13.5. While there seems to be variation in the performance among individual transceivers results are very encouraging. Due to the logistical challenges inherent in VHF telemetry and the reliability concerns of location estimates yielded by satellite-monitored transmitters, GPS transceivers may provide a dramatic improvement in our ability to accurately elucidate flyways, perch and roost sites, and foraging locations of California Condors further improving our conservation management strategies for the species.

**MODELING A POPULATION OF FERRUGINOUS HAWKS BASED ON NEST SUBSTRATE SELECTION WITHIN THE NATURAL GAS MATRIX: AN INITIAL INVESTIGATION.**

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Between 1987 and 1992, 71 artificial nesting structures (ANSs), for ferruginous hawks (*Buteo regalis*), were placed within the Shamrock Hills Area of Critical Environmental Concern (ACEC) to mitigate the effects of increased human disturbance. Prior to 1987, biologists had noted a high rate of nest failures in relation to increased human activity encroaching on ferruginous hawk nesting areas. In the last decade another 33 ANSs have been erected in various locations throughout the Bureau of Land Management (BLM) administered lands of the Rawlins Field Office (RFO). Past researchers have speculated that hawks nesting on ANSs are more productive than birds nesting on natural substrates. Ferruginous hawk nests monitored, between 1976 and 2003, within the RFO demonstrated mean productivity rates of 2.48 and 2.23 for ANSs and natural nests respectively. Reproductive and survivorship vital rates were developed for hawks nesting on both natural and artificial substrates and ran through a matrix analysis. The rate of population growth ( $\lambda$ ) is most elastic to adult survivorship and that hawks nesting on ANSs experienced an 8 % increase in adult survival. The growth rate for ferruginous hawks nesting on natural nests was .995 versus 1.15 for hawks nesting on ANSs. A similar difference between the fledging rates of natural and artificial nests is most likely due to increased depredation of young. It was concluded that, while the minerals development can negatively impact raptor populations in sagebrush steppe habitat, ANSs can be an effective mitigation tool for nesting ferruginous hawks.

**NESTING ECOLOGY OF URBAN COOPER'S HAWKS IN BERKELEY, CALIFORNIA**

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During three nesting seasons, 2002-2004, we trained a team averaging 24 people per season to search a 2782-ha area of Berkeley and Albany, (east of San Francisco Bay), California, for nesting Cooper's Hawks (*Accipiter cooperii*). The volunteer team averaged 570 hrs/season searching for new nest sites and monitoring known territories. For three years combined, we found 38 active nests, of which 35 were successful. Of 38 nesting events, the most common tree species used were American Elm (*Ulmus americana*) (n = 9), Coast Live Oak (*Quercus agrifolia*) (n = 6), and Monterey Pine (*Pinus radiata*) (n = 6), however, seven other species were used less frequently. Sixteen (42%) nest sites were along streets or in private yards, twelve were in city parks, and ten were on school campuses. Average nest density was 232, 309, and 198 ha/nest for each of the three years. These figures are comparable to the highest known Cooper's Hawk nest densities, measured in Stevens Point, Wisconsin, in the 1990s. Nesting productivity - judged from high counts of branchers - averaged 3.3, 4.2, and 3.8 young/successful nest for 2002, 2003, and 2004, respectively. Adult pairs were found on territories as early as mid-January. Nest building was observed from late February to late March, incubation from late March to mid-May, hatching from early May to early June, and branching from early June to early July. By mid-August no young hawks were seen on natal territories, although one adult pair was noted on a territory in late September. Nearly 600 prey items were collected and analyzed in 2002, which included 16 bird species and three mammals. Four species -- Mourning Dove (*Zenaida macroura*), American Robin (*Turdus migratorius*), Rock Pigeon (*Columba livia*), and Western Scrub-Jay (*Aphelocoma californica*) -- accounted for nearly three-quarters of all prey remains near the nest sites.

**RAPTOR MORTALITY DUE TO WEST NILE VIRUS IN SEVERAL STATES, 2002**

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Since it was first detected in the United States in 1999, West Nile virus had been found in a small proportion of raptors tested by public health and diagnostic laboratories. In 2002, raptor rehabilitators reported a sudden influx of sick and dying raptors, mostly red-tailed hawks (*Buteo jamaicensis*) and great horned owls (*Bubo virginianus*), primarily in the Midwestern region of the U.S. Although the overall effect of WNV on raptor populations during this time is unknown, it is estimated that thousands of raptors were affected. Commonly reported signs were nonspecific: lethargy, inability to fly/stand, non-responsive to danger, and emaciation. Diagnostic evaluation of 56 raptors has implicated WNV infection in many of the cases. Encephalitis and myocarditis were notable, although not consistent, among the cases. No associations between clinical presentation, pathologic findings, species, and age were found. The different manifestations of disease and pathology in these species are interesting and require further study, including experimental infection. Other causes of death were diagnosed in 13 cases, including a red-tailed hawk from which WNV was isolated. The reasons for the reported increase in raptor mortality during the 2002 season (and subsequently in 2003) in comparison to the previous summers are unclear and the subsequent ecological impact of WNV on raptor and other wildlife populations remain unknown.

**PREVALENCE AND HOST-SPECIFICITY OF BLOOD PARASITES IN CALIFORNIA RAPTORS: CONSERVATION PERSPECTIVES FROM A MOLECULAR APPROACH**

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Studies of host-parasite interactions in birds have contributed greatly to our understanding of the evolution and ecology of disease. In this study, we employed molecular techniques to determine the prevalence and study the host-specificity of blood parasites in California raptors collected at the Golden Gate Raptor Observatory during the years 2002-2004. The blood parasites studied were the haemosporidians of the genera *Plasmodium*, *Haemoproteus* and *Leucocytozoon*. We developed and tested polymerase chain reaction (PCR)-based diagnostic tests to amplify parasite-specific genes from avian blood samples and used these tests to describe the prevalence of these parasites within five raptor species. In total, 91 individuals were tested and 41 were positive for *Plasmodium* or *Haemoproteus* (45%). The majority of the blood samples (71/91) were taken from Red-tailed Hawks (*Buteo jamaicensis*). Of these, 27 were positive for these haemoparasites (38%). There was no significant difference in prevalence between males and females or between birds sampled from the Marin Headlands and counties of the Central Valley. Interestingly, of the 13 Cooper's Hawks (*Accipiter cooperii*) tested, 12 were positive for haemoparasites (92%), suggesting that this species is highly prone to infection. In addition, by sequencing the gene products, we determined phylogenetic relationships between individual bird species and their parasites. Preliminary results show that *Leucocytozoon toddi*, a species of *Leucocytozoon* commonly found in raptors, is highly divergent from *Leucocytozoon* found in passerine birds. In addition to the birds tested at the Golden Gate Raptor Observatory, we are now testing blood samples from birds that were presented to the UC Davis Raptor Center and the Lindsay Wildlife Museum to determine whether prevalence rates differ between healthy and diseased birds. Overall, this research project addresses the possible ecological and conservation implications of these host-parasite interactions.

**TWENTY-FIVE YEARS OF BALD EAGLE RESTORATION IN SOUTHERN CALIFORNIA AND THE CONTINUING EFFECTS OF DDT**

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Bald eagles (*Haliaeetus leucocephalus*) disappeared from southern California by the mid-1960's, primarily as a result of DDT contamination in the Southern California Bight. Between 1980 and 1986, the Institute for Wildlife Studies (IWS) released 33 bald eagles from hacking towers on Santa Catalina Island, CA in an effort to restore a breeding population. Nesting began in 1987, and in that year and in 1988 all the eggs broke in the nests. Analyses of egg contents indicated that high concentrations of DDE, a metabolite of DDT, were the likely cause of nesting failure. Beginning in 1989, IWS began an active manipulation of eggs to maintain and increase the eagle population, in conjunction with further hacking of birds. Eggs removed from the nests were incubated at the San Francisco Zoo and chicks were fostered back into nests. Hatching success of removed eggs was about 20%, but the Zoo also provided chicks produced by their seven pair of breeding eagles. Since 1989, IWS has released an additional 21 birds from hacking towers and successfully fostered 40 chicks into active nests. About 50% of released birds

left the island 2-3 months after fledging and have been reported from San Diego, CA to British Columbia. Minimum first year survival is greater than 70% and there are generally 15-20 resident eagles on the island, including five breeding pair. Thirty years after DDT was outlawed for use in the United States, DDE contamination continues to preclude successful breeding without human intervention. IWS plans to continue managing the bald eagle population until pollution levels decline to a point at which reproduction is possible, either through natural degradation or clean-up efforts being explored by the Environmental Protection Agency.

## **SELECTING ELECTRICAL DISTRIBUTION POLES FOR PRIORITY RETROFIT TO REDUCE RAPTOR MORTALITY**

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California's two largest electric utilities, Southern California Edison and Pacific Gas and Electric, operate electrical distribution facilities composed of millions of poles and many thousands of miles of circuit lines that are vital to the economy and quality of life. Raptors perch on these facilities and are sometimes electrocuted. Many distribution poles need retrofitting to be safe for raptors, but the utilities cannot afford to retrofit all the dangerous poles at once. We synthesized factors believed responsible for electrocutions, and constructed a preliminary rating system for selecting poles for priority retrofit. To upgrade this system we mapped and characterized ca. 8,500 poles throughout California, and we performed fatality searches within 15 m of each pole. We recorded many landscape and pole attributes, as well as attributes to characterize the landscape surrounding each pole. Of the more than 140 bird fatalities we found, 92 were raptors. These fatalities will be tested for associations with pole and landscape attributes to bring an empirical foundation to the rating system. The results of our study will foster more cost-effective retrofit programs from which funds are directed toward the most dangerous poles first.

## **VOCAL DEVELOPMENT IN AMERICAN KESTREL (*FALCO SPARVERIUS*) NESTLINGS**

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We studied the acoustical characteristics of calls made by nestling American Kestrels. A total of 563 vocal samples was obtained from 88 chicks (49 males and 39 females) from 20 broods. Thirteen frequency, three numerical, and two temporal characteristics were measured using audio spectrography. Discriminant function analysis failed to distinguish the calls of male and female chicks, but univariate and principal components analyses suggest that vocal ontogeny proceeds more rapidly in males than in females. The acoustical characteristics of call notes changed in a consistent manner as nestlings matured, and by day 16 chicks produced calls similar to those of adults.

**LANDSCAPE CHARACTERISTICS OF MISSISSIPPI KITE NESTS IN ARKANSAS**

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The Mississippi Kite (*Ictinia mississippiensis*) is a small insectivorous raptor associated with bottomland-hardwood forests in the Southeast. Currently, this species is *Endangered* in Tennessee, *Rare* in Missouri, and is considered a species of special concern throughout the Southeast. To gain insight into landscape features that may influence Mississippi Kite nest-site selection, we analyzed the landscape surrounding 19 Mississippi Kite nests and 19 randomly-selected sites located within the White River National Wildlife Refuge, AR. We characterized the landscape within the estimated Mississippi Kite home range size of 7850 ha. In addition, limited available data suggest that kites typically forage within 1 km of the nest. Therefore we repeated the analysis using a 314 ha plot. We classified habitat as water, agricultural field, pine plantation, oak-dominated forest, and roadways. We measured both the perimeter as well as the area of each habitat type by digitizing 2002 infrared aerial photos using ArcGIS 8.3 software. When analyzed at the large scale (7850 ha), measurements of cover types within Mississippi Kite home ranges do not differ significantly from random locations. However, Mississippi Kite foraging ranges (314 ha) had an overall greater ( $P = 0.03$ ) amount of open habitat (mean = 39.03 ha) than random sites (mean = 26.77 ha). Because Mississippi Kites are insectivorous, frequent prey deliveries must be made to young to support development and growth. Therefore, long forays to obtain prey could be energetically stressful to the foraging adults and leave chicks unprotected from predators. Therefore, we suggest that kites need an adequate amount of open foraging habitat within approximately 1 km of their nests. Our results could be useful in managing landscapes to provide more suitable habitat for the Mississippi Kite.

**AN ANATOMICAL COMPARISON OF THE HINDLIMB AND JAW OF NORTH AMERICAN HAWKS AND FALCONS IN RELATION TO PREY PROCUREMENT**

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Previous studies have indicated that differences in hindlimb and beak characteristics among raptors reflect differences in predatory mode and prey habits. Falcons kill primarily with their beaks, whereas most hawks kill with their feet, and it has been demonstrated that bird-eating raptors tend to have shorter, wider, deeper beaks and longer toes, in comparison with those that feed predominantly on mammalian prey. This study expands upon these findings by focusing on the myology of the hindlimb and jaw apparatus of North American hawks and falcons. Hawks are predicted to have stronger feet than falcons, which in turn are predicted to possess stronger jaws. Moreover, within groups, those with a greater propensity for mammalian prey are predicted to have comparatively stronger jaws and feet. Physiological cross-sectional area, which is proportional to the amount of force a muscle can produce, was measured for the major jaw adductors and digit flexors from multiple frozen specimens. Preliminary results suggest that differences in killing behavior are reflected in the gross muscle physiology of the jaw and hindlimb. The jaw musculature of falcons comprises a slightly greater proportion of total (hindlimb and jaw) muscle physiological cross-sectional area compared with that of hawks (~34% vs. ~17%), whereas the hindlimb musculature of hawks comprises a slightly greater proportion than in falcons (~83% vs. ~66.2%). The ultimate objective of this study is to elucidate the adaptive functional significance of musculo-skeletal characters as predictors of predatory capability and foraging ecology of these raptors.

**NESTING AND HABITAT USE OF SWAINSON'S HAWK IN THE LOWER MOKELUMNE RIVER WATERSHED, CALIFORNIA**

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The purpose of this study was to determine habitat use by the Swainson's Hawk (*Buteo swainsoni*) in the Lower Mokelumne River Watershed (LMRW), an area of extensive viticulture in California's Central Valley. Specifically, habitat use for nesting and foraging was characterized and compared among available habitats to see which habitats were selected by Swainson's Hawks, with particular focus on vineyard use. Habitat features that most distinguished nest sites from control sites were identified at three scales, and vineyard habitat was evaluated for its suitability for Swainson's Hawk nesting, using logistic regression. In addition, the effect of increasing vineyard area on the nesting population of Swainson's Hawks in the LMRW was investigated. Statistical analysis revealed that Swainson's Hawks forage and nest in vineyard habitat less often than expected by random choice. Conversely, they forage more in irrigated hayfields and nest more in ag-urban (rural) habitat. Though it is evident that Swainson's Hawks do not select vineyard areas for foraging per se, conspicuous use has been recorded. Foraging in vineyards appears to be most frequent early in the growing season. No strong relationship was found between vineyard foraging and the practice of planting cover between rows, but more detailed study is needed. Nesting distribution was found to be significantly aggregated for the non-vineyard area and random for the vineyard area, though not quite significantly. Swainson's Hawk nesting density was found to be over four times higher in non-vineyard habitats than in vineyard habitats. There was a strong negative correlation between nest presence and large-scale vineyard dominance. Logistic regression results showed a significant negative relationship between large-scale vineyard areas and nest presence.

**NESTLING SEX RATIO VARIATION IN BURROWING OWLS (*ATHENE CUNICULARIA*)**

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Our study examined adaptive sex ratio variation in burrowing owls nesting in the Snake River Birds of Prey National Conservation Area, Idaho during 1999 - 2004. Birds may alter sex ratios according to Fisher's hypothesis, local resource competition, local resource enhancement, or with physical condition. Fisher predicted equal investment in sons and daughters such that differential costs of production could skew sex ratios. Under local resource competition, parents skew sex ratios toward the dispersing sex. Local resource enhancement could cause parents to skew nestling sex ratios toward the philopatric sex. Finally, Trivers and Willard suggest that mothers in superior condition invest more in the sex with the greater variance in reproduction. Sex of 975 nestling burrowing owls from five breeding seasons was determined using DNA isolated from blood using a standard protocol (Fridolfsson and Ellegren 1999) involving PCR amplification of the CHD-1 gene found on avian sex chromosomes. Annual and brood sex ratios will be discussed in relation to the above hypotheses.

**RE-EVALUATING THE CONSERVATION STATUS OF THE CRITICALLY ENDANGERED MADAGASCAR FISH EAGLE (*HALIAEETUS VOCIFEROIDES*): HISTORICAL POPULATION DECLINE OR A NATURALLY SMALL POPULATION?**

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Previously described as a common species with a wide distribution in the 1800s, the island endemic Madagascar fish eagle has a current global population of 222 known individuals and is listed by IUCN as a critically endangered species. This status was assigned on the basis of a presumed 'drastic population decline' in the 1940s and a continually declining population thereafter, thought to be caused by direct and indirect persecution and habitat loss. We assessed the empirical evidence for decline by three methods: a critical review of the historical literature, an examination of museum specimen tag data, and a genetic comparison of historical and contemporary microsatellite DNA (tissue from museum specimens [n=32] and blood samples from the current population [n=84]). The historical literature review provides poor evidence for this species' previous occurrence outside its current range (western seaboard) and demonstrates that the population decline theory is based on hearsay and two unreliable sightings. An examination of museum specimen tag data shows that most eagles were collected within the species' current range, and those allegedly from outside the range [n=6] are associated with questionable provenance data; a common limitation when utilising historical museum collections. The molecular comparison demonstrates extraordinarily low genetic diversity in both the historical and contemporary populations. However, it provides no evidence of allele loss and thus no evidence of a genetic population bottleneck in this species. We suggest it is appropriate to review the criteria used to assign conservation status to the Madagascar fish eagle, to incorporate a better understanding and more appropriate management plan to ensure this species' survival.

**POLITICS AT THE NEST: UNUSUAL REPRODUCTIVE STRATEGIES AMONGST COOPERATIVELY BREEDING MADAGASCAR FISH EAGLES (*HALIAEETUS VOCIFEROIDES*)**

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The island endemic Madagascar fish eagle is patchily distributed, with 63 currently known breeding territories in perennial freshwater and brackish wetland and marine habitats along the western Madagascar seaboard. The majority of breeding territories support monogamous pairs, but polygamy has been observed in 10 breeding territories within the Soahania and Manambolo river catchments of the Antsalova area. Behavioural observations and molecular sexing of individuals within these polygamous groups reveal polyandry, polygyny, polygynandry and a homosexual 'pair': a uniquely diverse array of breeding strategies amongst raptors. Polyandry is the most common polygamous strategy amongst Madagascar fish eagles and polyandrous groups show inter-annual stability in group membership and social status. Status is governed by a linear dominance hierarchy (female, primary male, secondary male, tertiary male) in which rank is positively correlated with size. Primary, secondary and tertiary males show statistically identical copulation frequencies with the same female during the fertilisation period but subordinate males achieve higher copulation rates after the on-set of incubation. Dominance interactions between males are not associated with access to the female; surprisingly, conflict throughout the breeding

period primarily arises when the subordinate male(s) bring sticks and leaves to provision the nest or when they perch near to it (irrespective of female presence). Cooperative behaviour involving all individuals includes nest building, incubation, provisioning nestlings and territorial defence from intra- and inter-specific invasion. Subordinate males are more likely to be found on the nest when dominant males are absent and are often (but not exclusively) displaced when the dominant male returns. A high degree of homozygosity may be responsible for the poor hatching success observed in the Madagascar fish eagle. Polyandry could improve hatchability by maximising genetic input. Additionally, the eggs of polyandrous groups appear to hatch earlier than those of monogamous pairs, enhancing nestling survivorship through increased food provision and multi-adult (potentially parental) investment.

### **DUKING IT OUT: FACTORS THAT INFLUENCE SIBLING AGGRESSION IN RED-SHOULDERED HAWK NESTLINGS**

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Food supply, hatch order, and gender have been proposed as factors influencing nestling aggression in siblicidal birds. We examined the potential influence of these factors on sibling behaviour of Red-shouldered Hawks (*Buteo lineatus*) in northeastern Arkansas. We monitored eight nests for an average of 30 hr each using video surveillance cameras and one elevated blind. Four of the nests were supplemented with approximately 300 g of small mammals per week. Natural food deliveries as well as nestling behaviour were recorded for both supplemented and control nests. Preliminary results show higher aggression in four control nests (1.47 aggressive acts/nestling/hr) compared to two supplemented nests (0.48 aggressive acts/nestling/hr). At the two most aggressive nests, the oldest nestlings displayed higher mean levels of aggression with 3.62 aggressive acts/hr and 2.06 aggressive acts/hr compared to their younger siblings with 0.53 aggressive acts/hr (N = 2) and 0.58 aggressive acts/hr (N = 2), respectively. The nest with the highest frequency of aggression resulted in the siblicide of one of the youngest nestlings. The video data shows the nestling becoming progressively weaker due to aggressive abuse that ended when the older nestling pushed his younger sibling out of the nest. We will also examine the relationship of gender and nestling aggression as video data is under continuing analysis.

### **NATIVE RAPTOR SPECIES IN FREE FLIGHT AT THE ARIZONA-SONORA DESERT MUSEUM**

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The Arizona-Sonora Desert Museum (ASDM) is a world-renowned zoo, natural history museum and botanical garden, located just west of Tucson, Arizona. The Raptor Free Flight (RFF), offered at the ASDM, is a unique educational experience using native birds of prey demonstrating natural behaviors in a desert habitat. The program was developed as an alternative approach to displaying raptors on exhibit in enclosures. Flight demonstrations emphasize the behavioral ecology of each species and their role in the ecosystem. The natural habitat setting, level of interpretation material, variety of behaviors exhibited, and demonstration method differentiates the program from other bird shows. Species flown free include Barn Owls (*Tyto alba*), Great Horned Owls (*Bubo virginianus*), Ferruginous Hawks (*Buteo regalis*), Prairie Falcons (*Falco mexicanus*), Harris' Hawks (*Parabuteo unicinctus*), Chihuahuans Ravens (*Corvus cryptoleucus*), and Greater Roadrunners (*Geococcyx californianus*). Demonstrations are planned but can

comprise unexpected elements, including interactions with resident and migrant wild raptors and wildlife. The program was developed and is demonstrated by professional educators, biologists and animal trainers. As an informal environmental education program, the RFF is directed primarily at life-long learners with raptor conservation as the main objective of the program. The RFF has become a reliable source for information about raptor conservation for residents in Tucson.

## **AN OVERVIEW OF FACTORS INFLUENCING MALE PRODUCTIVITY IN MERLINS**

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This talk will summarize some findings from a 25-year study of Merlins, concentrating on the breeding performance of males and factors influencing both annual and lifetime productivity. Based on data from the Saskatoon population, male Merlins varied in their age of entry into the breeding population. Those entering as 1-year old birds tended to occupy poorer quality nest sites and produced significantly fewer, later hatching fledglings than older individuals. Birds that commenced breeding as a 2-year old occupied nest sites of similar quality to yearlings, but had larger, earlier hatching broods than did yearling males. In the first 3 years, males that lived to breed again had higher productivity than those which died, while the trend was reversed for those aged 4 and 5 years. Similarly, those that survived an age class tended to occupy higher quality nest sites than those that died. Lifetime reproductive success was significantly correlated with longevity but also with nest site quality. However the mechanism underlying productivity in males appeared to be more strongly linked to individual quality than that of the nest site occupied. The longest lived males in this population were 8 years old, but with juvenile mortality at 77% and adult mortality at 38%, very few individuals reached this age and average lifespan was only 2.7 years. Male Merlins produced from 0 to 32 fledglings during their lifetime, averaging 7.4, with about 10% of male offspring recruited back into the Saskatoon population.

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**INJURY AND DEATH - A RAPTOR'S PARADOX: SURVIVAL RATES FOR WINTERING RAPTORS SUSTAINING INJURIES**

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Because raptors attempt to capture and subdue potentially harmful and quick prey, these predators would most likely be selected against if they incurred an injury that impaired their defense or ability to capture prey. Here, we present results from 99 wild-caught raptors that support the converse claim; that raptors can and do survive with many types of injuries. We report a conservative injury estimate of 12.12% for wintering populations of Red-tailed Hawks (*Buteo jamecensis*), American Kestrels (*Falco sparverius*), and Cooper's Hawks (*Accipiter cooperii*) in northeast Arkansas. Injuries documented in these species included broken/missing talons, flaking/bleeding scales on one or both legs, missing toes, past bone breaks, or eye maladies.

**HISTORICAL DISTRIBUTION AND GENETIC POPULATION STRUCTURE OF THE GOLDEN EAGLE (*AQUILA CHRYSAETOS*) IN THE BRITISH AND IRISH ISLES**

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This study has used data from historical literature, manuscripts, and egg collections to plot the breeding distribution of the Golden Eagle among the islands of Britain and Ireland prior to the 20<sup>th</sup> century. In Ireland the species bred throughout the northern and western seaboard up to the late 19<sup>th</sup> century. In Britain regular breeding occurred throughout the highlands of Scotland, in the Orkney Islands up to the middle of the nineteenth century and in Cumbria up to the late 18<sup>th</sup> century. Single records of breeding were reported as far south as Derbyshire in the late 17<sup>th</sup> century and as far north as the Shetland Islands in the early 19<sup>th</sup> century. The data suggest a decline in population with a possible impact on genetic population structure. A large set of microsatellite loci (n=72) developed in various Accipitridae species were checked for utility in the Golden Eagle and from these a set of suitably polymorphic loci (n=18) were identified. These loci were used to genotype DNA extracted from foot tissue from 95 museum specimens and blood and feathers obtained from 155 breeding territories in order to determine the genetic structure of historical and modern populations respectively, the extent to which decline has changed the genetic structure of the islands' population and the relationship between extinct and extant populations. Such information would help inform and direct conservation management of the species in the Isles.

**WAVE MOLT OF THE PRIMARIES IN ACCIPITRID RAPTORS, AND ITS USE IN AGEING IMMATURES**

**WILLIAM S. CLARK**, 2301 S. Whitehouse Circle, Harlingen, TX 78550, USA.

Primaries of Accipitrid raptors are replaced sequentially outward from the inner P1 to the outer P10, forming a wave. Many species in this family do not replace all ten primaries during the annual molt cycle. They begin the next molt cycle by continuing where the molt left off on the last cycle, AND, importantly, beginning a new wave of primary molt at P1. Knowledge of primary molt can be an important aid in ageing raptors that take more than one year to reach Definitive plumage, *e.g.*, eagles, and in determining the first adult plumage of species that usually do not replace all primaries in the first molt, *e.g.*, Red-tailed Hawk (*Buteo jamaicensis*) and Rough-legged Hawk (*B. lagopus*). Juveniles always show all primaries the same age. Many first adult plumage raptors show one to three retained juvenile outer primaries. Basic II eagles replace fewer primaries and show from three to six new inner primaries and the rest retained faded juvenile outer primaries. Basic III eagles show new inner primaries (from one to four), some new primaries farther out on the wing, beginning where the last wave of molt left off, in many cases, new P6 to P8. They usually show retained juvenile outer primary P10. Basic IV eagles show three waves of new primaries: inner, mid-primary, and new P10. An advantage of molting primaries in two or more locations is that large gaps in the outer wing are avoided. I have noted wave molt in more than 75 species of Accipitrid raptors, including some as small as Broad-winged Hawk (*Buteo platypterus*) and Black-shouldered Kite (*Elanus caerulus*).

**HEN HARRIERS (*CIRCUS CYANEUS*) AS DIRECT ENVIRONMENTAL INDICATORS**

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**MICHÈLE L. CLARKE** and **ANDREW D.M. DOBSON**, School of Geography, University of Nottingham, University Park, Nottingham NG7 2RD, UK.

The dynamics of raptor population sizes and ranges are widely regarded as barometers of the health of the environment. More direct uses of raptors as indicators are rare. There has been considerable concern in Europe about declines in populations of farmland birds. Reduced overwinter food supplies on modern farms have been implicated as the one of the principal causes. Monitoring diets of farmland birds has been severely limited due to the biases and difficulties associated with methods such as observation and faecal analysis. Hen Harriers wintering in lowland England forage mainly for small seed-eating farmland birds – larks, *Alaudidae*, accentors, *Prunellidae*, finches, *Carduelinae*, and buntings, *Emberizidae*. Seeds in the upper digestive tracts of prey at time of capture are ingested by harriers and egested in pellets. Large samples of pellets collected at harrier communal roosts show a general dependence by prey on a limited range of arable weed seeds, but also inter-specific differences in diet and intra-specific differences between geographical regions. We plan to use a network of harrier roosts routinely surveyed in eastern and southern England to develop a GIS-based model of habitat use by both harriers and their prey, expressing the trophic links between weed seeds, farmland birds and harriers. The aims are to assist: with predicting and monitoring the effects on biodiversity of changes in cropping mosaics and crop management, due to rapid technological changes such as GM; with delineating the Special Protection Areas required to be established for listed species by European Union law; in comparison with breeding season ranging studies, with identifying marginal breeding habitat for re-colonisation by the Hen Harrier, a red-list species in the UK.

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**CONSERVATION ASSESSMENT AND STRATEGY FOR THE BALD EAGLE  
(HALIAEETUS LEUCOCEPHALUS) IN ARIZONA**

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Herein, we describe the history, current status, and management activities needed to maintain Arizona's Bald Eagle population. We summarize the statewide distribution and productivity history, identify current and potential threats to the population, and outline the foundation for future Bald Eagle management. The Arizona population has recovered under Endangered Species Act of 1973 (ESA) protections, and we have intensively studied demographics to identify the potential challenges Bald Eagles face absent ESA protection. Threats include increasing human recreation pressures, development in or near the best breeding habitat, limitations of nesting habitat, effects of environmental contaminants, the extirpation of native prey species, and a variety of mortality agents. We report current data on these threats, their effects on Bald Eagle productivity and survival, and outline the management necessary to counteract these population stresses.

**RAPTOR AND CORVID USE OF POWERPOLES FOR NESTING IN THE CARRIZO  
PLAIN NATIONAL MONUMENT, SAN LUIS OBISPO COUNTY, AND LOKERN  
NATURAL AREA, KERN COUNTY, CALIFORNIA**

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The Lokern Natural Area (LNA) and valley portions of the Carrizo Plain Natural Area (CPNA) have few natural nest substrates for corvids and non-ground nesting raptors, however both have powerpoles that can potentially support large stick nests. In the LNA, I surveyed all major traversing spans of powerlines from 1999 to 2004, a maximum of 512 tower structures. In the CPNM, I surveyed all major traversing spans of powerlines from 2000 to 2004, a maximum of 278 tower structures. Six bird species were documented attending towers with stick nests: White-tailed Kite (*Elanus leucurus*), Red-tailed Hawk (*Buteo jamaicensis*), Prairie Falcon (*Falco mexicanus*), Great Horned Owl (*Bubo virginianus*), American Crow (*Corvus brachyrhynchos*) and Common Raven (*Corvus corax*). Depending on year and location, Common Raven nests ranged from approximately 60% to approximately 80% of nests found on powerline structures. The majority of bird nests were located on only a few of the available types of tower structures. Of the types of towers with high occupancy rates, few had no nests any year and many had nests each year of the study.

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**RAPTOR OCCURRENCES, INCIDENCE OF NESTING, AND AN ASSESSMENT OF PREY AVAILABILITY ON RETIRED AGRICULTURAL LANDS IN THE SAN JOAQUIN VALLEY, CALIFORNIA**

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From 1999 to 2003 we monitored wildlife use on approximately 800 ha of retired farmland near Tranquillity, Fresno County, California. Four experimental restoration treatments were applied to 20, 4-ha study plots configured in a randomized block design. We conducted winter raptor surveys along a 17.7 km road transect adjacent to these restored lands and we performed annual nest surveys and quarterly small mammal trapping on study plots. Survey results allowed an assessment of the value of restoration in providing habitat and prey for raptors. The number of wintering raptor species increased each year (except in 2002) reaching seven in 2001 and 2003. Among the raptors using the site were the American Peregrine Falcon (*Falco peregrinus anatum*), a California endangered species, the Prairie Falcon (*Falco mexicanus*), Northern Harrier (*Circus cyaneus*), Ferruginous Hawk (*Buteo regalis*), Burrowing Owl (*Athene cunicularia*), and the Short-eared Owl (*Asio flammeus*) which are California special concern species. Raptor abundance increased annually, except in 2003. American Kestrels (*Falco sparverius*), Red-tailed Hawks (*Buteo jamaicensis*), and Northern Harriers were the most frequently observed raptors. Approximately 25% of the Red-tailed Hawks observed in 2002 and 2003 exhibited dark (melanistic) morphology, and were often ground roosting. Three Short-eared Owl nests were found in 2002 and high numbers were observed roosting in winter of 2003. One Northern Harrier nest and one Burrowing Owl burrow occurred on study plots in 2003. The abundance of small mammals fluctuated seasonally and yearly. In 2,400 trap nights conducted each season, we captured the fewest number of small mammals (27 individuals) in fall 1999 and the greatest number (996 individuals) in summer 2001. Most (98%) of the small mammals captured were deer mice (*Peromyscus maniculatus*), but six other species also were captured. This relatively high diversity and abundance of small mammals is suspected to provide an adequate prey base for raptors in the project vicinity.

**CORONA TESTING OF BIRD COLLISION MITIGATING DEVICES**

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One of the most common ways to reduce avian collisions with power lines is to mark wires, making them more visible. Although several products are available to mark lines, there can be engineering/maintenance issues associated with placing devices on energized wires. One of the issues associated with marking devices is corona discharge. Corona discharges occur when surface electric field intensity surrounding an energized electrode exceeds a critical value resulting in a localized ionization of the surrounding gas, in most cases air. Corona activity generates light (mainly in the UV spectrum), sound waves, electromagnetic radiation, ozone, and other by-products. Corona activity on power lines can result in audio noise (AN) or radio interference (RI) complaints. Since corona may result in customer complaints, it is important to know how marking wires might influence corona. This information will give biologists and engineers the information they need to determine the voltage of wires they can mark without creating AN or RI. July 2004, EDM International, Inc. (EDM) engineers assessed corona discharge on various products designed to attach to power lines to mitigate bird collisions. Testing was performed at the EPRI Solutions Lenox test facility using a DayCor camera that detects and displays the

level of corona discharge on a video image. The products were tested over a common range of transmission voltages and all products yielded similar levels of corona at the various voltage levels.

## **RAPTOR ELECTROCUTION MITIGATION SEARCH ENGINE AND WEB SITE**

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Despite a wealth of information on avian interactions with power lines, problems throughout the world persist. Effective retrofitting of utility poles requires succinct information that can be transferred to utility engineers and linemen. There are also numerous products available to retrofit lines but there is not a common location to view and obtain information on these products along with information on the advantages and disadvantages of each product. EDM International, Inc. created a utility web site that incorporates typical California distribution overhead power line configurations associated with historic mortalities along with recognized retrofitting solutions. The site contains a search engine with detailed product information, including photos and web site hot links for all raptor electrocution mitigating products. The search engine allows sorting based upon the type of problem (e.g. bird contacts, nesting), the type of utility equipment involved (e.g. transformers, arresters, etc.) and product mechanism (e.g. insulation, perch deterrent, etc.). There is also a secure section for utility testimonials on the effectiveness of a particular product and common application problems. This project leverages off previous work on animal-caused outages developed by EPRI in 2001.

## **RAPTOR ELECTROCUTION IDENTIFICATION FIELD GUIDE**

**JOEL HURMENCE** and **RICHARD E. HARNESS**, EDM International, 4001 Automation Way, Fort Collins, CO 80525 USA

In order to address avian fatalities, many utilities are now checking their equipment for potential areas that may pose hazards for birds. A common method of monitoring is to look under power lines for dead birds. Identifying species for these fatalities is important for several reasons. First, since eagles are afforded special protection under the Eagle Protection Act, it is of interest to know if a bird fatality is an eagle. Secondly, it is important to identify the species of each fatality in order to choose the most effective type of retrofit. Some retrofitting methods are effective for medium-sized raptors, but not sufficient for eagles. Finally, it is useful to understand which species are found in a given area in order to help identify other structures in similar habitats that can pose risk to those species. When decomposed carcasses, bone pieces, feathers, or pellets (castings) are found under electrical structures, it can be difficult to identify the species. As a resource for such research, EDM International, Inc. created a guide for the identification of partial remains of selected avian species. The guide includes measurements of the major bones and a series of photos showing comparisons of raptor skeletons, feathers, and castings. Information on other commonly electrocuted species such as the American Crow is also included in the guide.

**COOPERATIVE POLYANDRY IN GOLDEN EAGLES (*AQUILA CHRYSAETOS*)**

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Most raptors are monogamous, highly territorial and thus aggressive toward extra-pair adults. Trios of adult raptors are infrequent and documented cases of cooperative polyandry are rare. In golden eagles (*Aquila chrysaetos*), trios of adults have been reported but few observers have subsequently identified the sex and participation of these individuals in nesting activities. I have been monitoring a golden eagle nest near Dublin, CA for 15 years. During three years (2000, 2001, and 2002), I observed a trio of breeding golden eagles that participated in a cooperative polyandrous mating system. Polyandry in a normally monogamous population may be a result of abnormal disturbance in a small population, unfavorable feeding conditions, or saturation of breeding territories. I will be discussing these issues and presenting my observations in this poster.

**BOREAL OWL (*AEGOLIUS FUNEREUS*) USED AS AN INDICATOR SPECIES TO STUDY THE EFFECTS OF LOW-LEVEL MILITARY JET FLIGHTS**

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Given the relatively large number of low-level jet flights along the river valleys of the Québec-Labrador Military Training Area and the biological importance of these valleys, a research program has been developed to investigate impacts on the ecological components of these valleys. The boreal owl was selected as an indicator species. If their hearing capacities are affected, adults may be less efficient hunters, leading to lower reproductive success. Boreal owls also readily use nest boxes, which facilitates the location of nesting sites in a relatively inaccessible study area. Thus, 600 nest boxes were installed in the fall of 2003 along stretches of rivers which can be visited by canoe or snowmobile; half are located within the military training area, the other 300 in an adjacent control area. Data will be gathered to compare occupation rates, nesting effort and success, food provisioning efficiency (using movement detectors and video cameras), and survival rates between the flight zone and the control area. Small mammal sampling carried out in September 2003 indicated peak populations (35 captures/100 trap-nights), promising good conditions for the following reproductive season. In 2004, the occupation rate was much greater (19%) in the control area than in the training area (6%). However, we obtained unexpectedly high predation rates (77%) and disturbance caused by porcupines gnawing the boxes, mostly within the flight zone where hunting and trapping effort seems lower than in the control area. This led to only one nest box still being occupied in the training area in late May, compared to 13 in the control area. These results preclude making any meaningful comparisons between the two areas. Predator and porcupine guards will be installed and small mammal populations will be sampled in September 2004, and nest boxes will be monitored again in 2005.

**CORE AREA OF THE HOME RANGE OF THE JAPANESE MOUNTAIN HAWK-EAGLE  
(*SPIZAETUS NIPALENSIS*) IN JAPAN**

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We surveyed the home range of one pair of radio-tagged Japanese Mountain Hawk-Eagles in the Suzuka Mountains, Japan. The male was tracked from April 1998 to March 1999, and the female was tracked from August 1997 to March 1998. 1013 locations were sampled for a total of 1323 hrs. Also 214 times of hunting behaviors, 231 times of breeding behaviors and 24 times of roosts were recorded. The size of the home ranges was 11.73km<sup>2</sup> (Male; 10.74km<sup>2</sup>, Female; 8.90 km<sup>2</sup>) calculated with the Minimum Convex Polygon Method, 7.90 km<sup>2</sup> (Male; 6.98 km<sup>2</sup>, Female; 5.53 km<sup>2</sup>) with Grid Cell Method and 5.66 km<sup>2</sup> (Male; 4.14 km<sup>2</sup>, Female; 4.17 km<sup>2</sup>) with Kernel Method (95% probability). We defined the core area as the 95% Kernel home range because the 95% Kernel home range was the concentrated area in comparison with the other home ranges. Concerning the utilization distribution, 67% of the 95% Kernel area of hunting behavior, 97% of the breeding behavior sites and 100% of the roost sites were contained inside of the core area. Therefore, the core area was identified with the necessary area not only as the concentrated use, but also to maintain the breeding success for pair. The shape of the core area was not concentric circle with two isolated areas. It seemed that the geographical features like as the large valley and the road were related to it.

**PRODUCTIVITY OF PEREGRINE FALCONS (*FALCO PEREGRINUS*) ON THE UPPER  
YUKON RIVER, ALASKA: EFFECTS OF WEATHER, HABITAT, AND DEMOGRAPHIC  
CHARACTERISTICS**

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The number of pairs of Peregrine Falcons nesting along the upper Yukon River, Alaska, increased from 10 in 1975 to 45 in 2000. During this 26-year period, however, the proportion of pairs with young and the number of young per pair (productivity) declined ( $P < 0.01$  and  $P = 0.02$ , respectively). We examined the relationship between productivity and a suite of biotic and abiotic variables for 774 pairs at 55 territories. Productivity was greater in years with higher mean temperature during May ( $P = 0.01$ ) and lower monthly precipitation during April ( $P = 0.06$ ). In general, falcons in the most frequently occupied territories produced more young ( $P < 0.01$ ). Pairs that established aeries with overhanging rock ( $P < 0.01$ ) and on higher cliffs ( $P < 0.01$ ) were more productive. Nest height on cliff ( $P = 0.25$ ) and nest aspect ( $P = 0.14$ ) were not useful predictors of productivity. The composition of the landscape within 5 km of the nest site explained 19% of variation in productivity for 53 pairs ( $P < 0.01$ ). Higher reproductive output was associated with a greater proportion of meadows and a lower proportion of shrub habitat. Median distance between breeding pairs was 4.21 km. Productivity may have been higher for pairs more distant from their nearest neighbor ( $P = 0.09$ ). Multiparous females did not produce more young than inexperienced (primiparous) females ( $P = 0.21$ ). In general, Peregrine Falcons selected nest sites that maximized reproductive output, but some pairs were apparently forced to occupy lower-quality territories as population density increased. Stochastic weather events also affected reproductive success. Future work should focus on the effects of landscape composition at multiple spatial scales, habitat patch size,

and patch interspersions on productivity. Additional potential causes for reduced productivity in this population should also be investigated, including environmental contaminants and extreme weather events.

### **EFFECTS OF NEST CLEANLINESS ON BURROW REUSE BY BURROWING OWLS (*ATHENE CUNICULARIA*)**

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We investigated the effects of nest cleanliness on burrow reuse by Burrowing Owls nesting in southwestern Idaho in 2004. Artificial burrows used for nesting by owls in the previous year were placed into one of three treatments: 1) control, old nest material (dung, bones from prey, other accumulated materials) removed and replaced without modification; 2) microwave, old nest material removed, microwaved to kill potential ectoparasites, and replaced; or 3) removal, old nest material removed from burrow. Control burrows (n=10) had the highest reuse rate (50%). Microwave burrows (n=9) and removal burrows (n=17) both had much lower reuse rates (22% and 12%, respectively). The observed difference in reuse between control and removal burrows may derive from the presence of old nesting material acting as a signal of suitability, in that old material may indicate to owls that they have encountered an acceptable nest site. The low reuse rate for microwave burrows may indicate that the presence or absence of ectoparasites is unimportant to Burrowing Owls when selecting a nest burrow. Confirmatory tests of these initial hypotheses are planned for 2005.

### **DISTRIBUTION AND PRELIMINARY HABITAT ANALYSIS OF THE WESTERN BURROWING OWL (*SPEOTYTO CUNICULARIA HYPUGAEA*) IN WESTERN RIVERSIDE COUNTY**

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The Western Burrowing Owl was once widespread across the west. Even as far back as the 1930s and 40s the bird was fast declining from the grasslands and deserts west of the Mississippi. Owl populations continue to decline with the rapid expansion of urban development in this county. Management strategies for the Western Burrowing Owl will depend on maintenance of appropriate habitat for nesting and foraging. It is still unclear what comprises “appropriate” habitat. For example, the MSHCP for Western Riverside County specifies (based on inexact and sporadic records) five potential reserve sites where owls should be maintained. We conducted surveys through two breeding seasons and two summers to locate current owl nesting sites. Of those five sites, our survey results show that owls do not regularly occur in two of them, and, although two more of the sites have not yet been surveyed, interviews suggest that Burrowing owls are not regular occupants at these locations. Thus, only one of the proposed “core” reserve sites is likely to support a regular population of owls. In a preliminary map of the region, using Raster-based GIS techniques (ArcGIS 8.3 and ArcInfo 8.3), we created a potential distribution map of the owls based on observations at current known locations of breeding pairs. Our initial habitat map was created using variables stored in GIS layers and based on the current literature suggesting variables that may be important. Those variables were vegetation, rock outcrops, distance to water, slope, and elevation. The four dominant vegetation types near nests were: alkali playa, field cropland, non-native

grassland and riverside sage scrub. We are currently conducting further analysis using GIS and statistical analysis (SAS 8.2) to generate additional predictive models of the Burrowing Owl's distribution and habitat needs.

## **ECOLOGY OF BARRED OWLS (*STRIX VARIA VARIA*) IN FIRE-PRONE FORESTS OF EASTERN WASHINGTON**

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Understanding ecological interactions between spotted owls (*Strix occidentalis caurina*) and barred owls may be critical for long-term conservation and management of spotted owl populations in the Pacific Northwest, particularly in areas where forest fire fuel reduction and dry forest restoration are management priorities. We are conducting a radiotelemetry study of barred owl movements to compare barred owl habitat selection to published information on spotted owls. This study is taking place in dry, fire-prone, mixed-conifer forest in the eastern Cascades of Washington. The study area encompasses 24,500 ha within the Leavenworth and Lake Wenatchee Ranger Districts of the Wenatchee National Forest. Our objectives are to identify resource selection functions for barred owls at three scales: 1) Comparing habitat characteristics within barred owl home ranges to habitat characteristics within the study area. 2) Comparing habitat characteristics around radiotelemetry locations to habitat conditions within the home range. 3) Comparing habitat characteristics at barred owl nest sites to randomly selected sites. Field work for this project started in March 2004 and will continue through September 2005. This poster will summarize preliminary results from our first season of field work (April – September 2004).

## **WINTER RAPTOR DENSITIES AND HABITAT USE IN NORTHERN MEXICO BASED ON ROADSIDE SURVEYS**

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Roadside raptor surveys were conducted along various highways throughout four northern Mexican provinces that represent a variety of geographic and environmental habitats. Perch substrates were also tabulated in order to examine patterns of overall habitat usage across species. Six transects, covering a combined distance of 1006.8 km, revealed that seven species of raptors, including ravens, accounted for 95% of total observations. The Turkey Vulture (*Cathartes aura*) > Black Vulture (*Coragyps atratus*) > Chihuahuan Raven (*Corvus cryptoleucus*) > American Kestrel (*Falco sparverius*) > and Red-tailed Hawk (*Buteo jamaicensis*) accounted for 95% of the total number of individuals counted. Raptor densities were estimated for the most common species in each region using the program DISTANCE 3.5. The areas surveyed differed in species composition, as did the densities of the five most common species. Approximately 95% of raptor observations were accounted for by four broad-based habitats (agricultural > roadway > desert scrub > grassland > riparian). The frequency of observations among these habitats differed significantly across species and areas surveyed. These results describe the relative abundance of observed raptors in northern Mexico, and shed some light on their tendencies to utilize certain habitats and perching substrates.

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