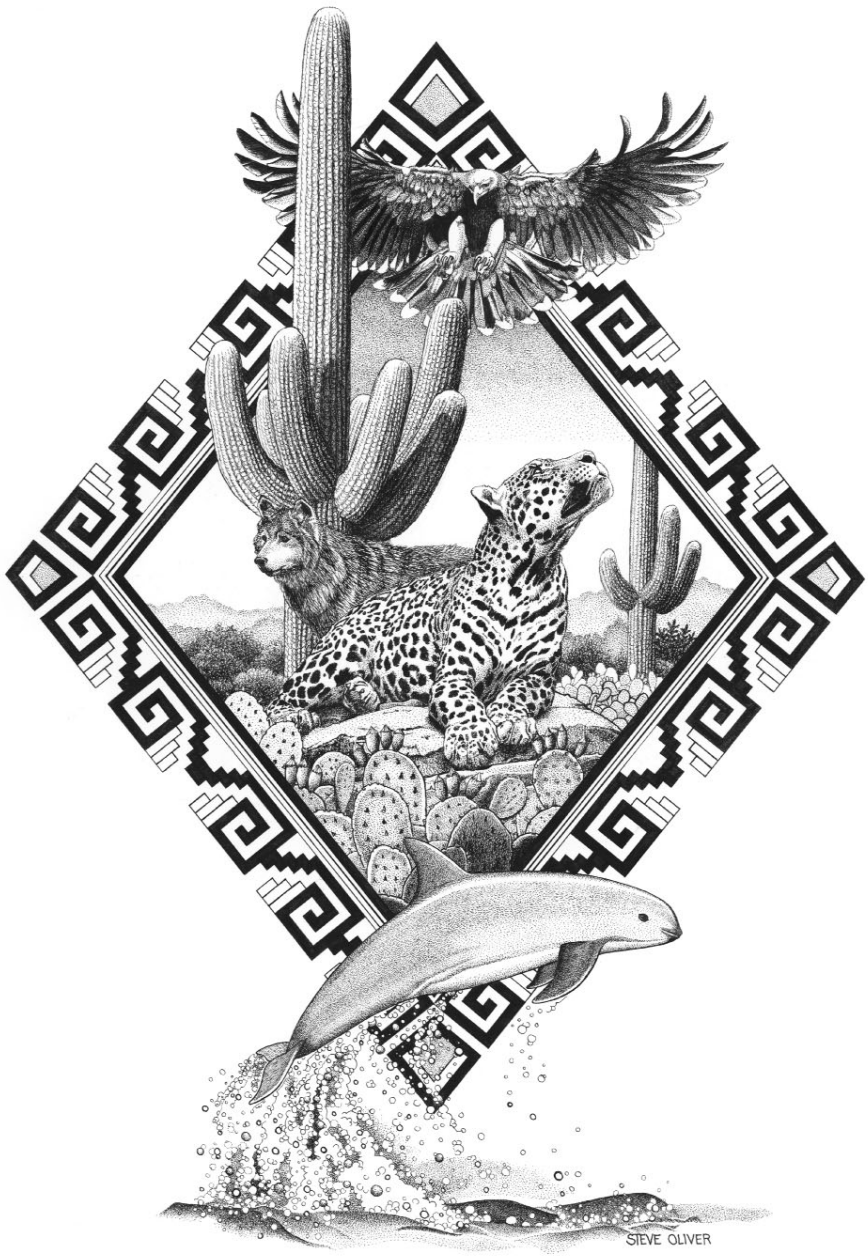
PROGRAM and AGENDA

For Defenders of Wildlife's

# CARNIVORES 2004

## *Expanding Partnerships in Carnivore Conservation*




**NOVEMBER 14-17, 2004 • SANTA FE, NEW MEXICO**

Compiled by Aimee Delach, Defenders of Wildlife
Cover Art by Steve Oliver

# PREFACE

Welcome to Defenders of Wildlife's "Carnivores 2004: Expanding Partnerships in Carnivore Conservation." This, our fifth biennial carnivore conservation conference, represents a unique opportunity for academics, agency staff, activists, educators and the public to gather to discuss carnivore biology and conservation. Our last conference, in Monterey, California in 2002, resulted in the publication last month of *People and Predators: From Conflict To Coexistence*, a book in which presenters from Carnivores 2002 elaborate on ways to reduce conflicts between humans and carnivores.

Taking stock of the status of carnivores in 2004, we find that many of the threats identified in previous conferences continue. Some of these stem from four years of a presidential administration whose view of its role in enforcing wildlife laws has ranged from reticent to openly hostile. Delisting has been proposed for wolves in the eastern United States, even though wolves have not yet returned to habitats in New England. Interior Secretary Gale Norton has refused to intervene to halt aerial gunning of wolves in Alaska, which clearly seems to be in violation of federal law. The Bush administration also has continually dragged its heels on listing of species and designation of critical habitat. And in a move blatantly designed to appease its friends in the mining, oil, gas and timber industries, the administration announced recently that it no longer believes it is required to comply with a federal regulation that mandates that federal forest managers maintain viable wildlife populations on national forest lands — a management objective critical to maintaining healthy carnivore populations. At press time, the presidential election was still several weeks off; undoubtedly, a subcurrent of this year's conference will be speculation on what the election results will bode for the future of carnivores.

Nonetheless, despite four years of failure of political leadership, carnivore conservation efforts are continuing to move forward, thanks to new and innovative partnerships like many you will hear described during this year's conference. Defenders of Wildlife and other conservation organizations are partnering with ranchers and landowners, businesses, state, local and federal agencies and others to reduce the incidence and impacts of conflicts with wolves, bears and other carnivores. You can hear about much of this work in the "Wolves and Livestock" and the "Carnivores and Humans" sessions. This year's program also emphasizes the important role that zoos, parks and schools play in advancing conservation, research and outreach to the public.

This year's conference will also break new ground with sessions on the economic and ethical importance of maintaining successful populations of carnivores and the habitats upon which they depend. It is clear that predator conservation in the 21st century will require the developmnt of ever-expanding partnerships and new ways of integrating knowledge and action. Defenders of Wildlife hopes that this conference will help promote that development.

*Rodger Schlickeisen*
*President, Defenders of Wildlife*

# Conference Agenda

## Saturday, November 13

### 6:30 p.m. - 9:30 p.m. (Santa Fe Room)

**The Passionate Fact: Storytelling Scientific & Informational Content, a workshop by Susan Strauss.**

Facts can lie as dead pieces of information on the listeners' ears. But, woven into story, they come to life. Henry Thoreau, David Attenborough and other great teachers of natural history practice an art of weaving their nature observations into a garment of meaning and beauty that touches something deep within the human soul. Susan Strauss calls this art "a story way of giving information." Our life experiences and the field observations of biologists provide a wealth of story material. This workshop is designed to invigorate and refine these anecdotal stories for use in public and political presentations of scientific information. Even the most confirmed non-storyteller will find this workshop enjoyable, accessible and immediately useful. Susan Strauss is an author, storyteller, and an associate professor at the Stephen Austin State University, and serves as affiliate faculty at University of Idaho. Her material is generated from extensive research in linguistic, anthropological, and biological texts. Recognized as one of the finest storytellers in the country today, she frequently gives workshops and performances for museums, the National Park and Forest Service, aquariums and zoological conferences, literacy conferences and schools throughout the U.S. and Europe. Her website is www.straussstoryteller.com.

## Sunday, November 14

### 8:00 a.m. to 7 p.m.

**Registration (Pre-function area outside of Santa Fe Room)**

**Exhibitor Hall Setup (Santa Fe Room and New Mexico Room)**

**Poster Setup (Mezzanine Level)**

**Speaker Prep Room available (Board Room)**

### 9:00 a.m. to 4 p.m.

**Field Trip to Bandelier National Monument**

Buses depart from the San Francisco Street entrance to La Fonda at 9:00 a.m., 9:30 a.m. and 10 a.m. for this six hour trip - please adhere to the departure time on your ticket. Join fellow conference attendees on a trip to Bandelier National Monument, home to the Pueblo people for nearly 500 years. Spend time at the visitor center learning about the history and culture of the people who made Bandelier their home, then take a guided tour of the 1.4 mile paved Main Loop Trail to view the Kiva, Tyuonyi village, and the cliff dwellings (a portion of this trail is wheelchair accessible). There will likely be time for an optional hike to the Ceremonial Cave, located 1/2 mile from the Main Loop and accessible by ladder. After a box lunch, we will visit one of the nearby Indian Pueblos to learn more about Native American culture in modern New Mexico.

### 7:00 p.m. to 9:30 p.m.

**Icebreaker (La Fonda Ballroom)**

Join old friends and meet new ones at a dessert reception in the ballroom of the La Fonda hotel. This event is free for registered participants. Please wear your name badge for admission. Spouses may attend for $10, payable at the door.

# MONDAY, NOVEMBER 15

| | LUMPKINS BALLROOM SOUTH | LUMPKINS BALLROOM NORTH |
|---|---|---|
| **8:00 a.m.** | Plenary session, featuring Gloria Flora of Sustainable Obtainable Solutions, and The Honorable Tom Udall, U.S. Representative from Santa Fe (Invited) .....1 | |
| **10:00 a.m.** | **MOUNTAIN LION CONSERVATION I .....2**<br>1. Identifying Human-Caused Mountain Lion Mortality Hotspots in the American West<br>2. Ensuring Public Safety and Cougar Persistence Through Science and Education: Project CAT and Cougar Awareness<br>3. Puma-human Interactions in Cuyamaca Rancho State Park, Southern California<br>4. 4-H and FFA's Livestock Depredation Reduction Efforts<br>5. A New Paradigm for Mountain Lion Conservation and "Management" in the 21st Century | **PARTNERSHIPS IN RESEARCH & CONSERVATION.....7**<br>1. AZA Partnerships: 135 Million Person Audience and $7 Million in Funding<br>2. A Zoo's Role in the Multi-Institutional Island Fox Recovery<br>3. AZA Zoo Professionals Assist with Brown Bear Field Study<br>4. Linking *In-Situ* and *Ex-Situ* Conservation Efforts: An Essential Strategy With the Bush Dog<br>5. Use of Citizen Science in Carnivore and Mammal Research*<br>6. Working With Local Communities To Resolve Conflicts With Endangered African Wild Dogs |
| **12:15 p.m.** | **LUNCHTIME PRESENTATION— "EYE OF THE WHALE" .....19** | |
| **1:30 p.m.** | **MOUNTAIN LION CONSERVATION II.....20**<br>1. Prey Selection and Kill Rates of Cougars in Northeastern Washington<br>2. Public Opinions And Actions Relating To Mountain Lions In Southern California: Implications For Management Agencies<br>3. Project CAT (Cougars and Teaching)<br>4. The Mountain Lion and the City Lion: Approaching Coexistence in Changing Landscapes | **MARINE SPECIES .....24**<br>1.Using Marine Mammals and Other Apex Predators to Monitor Ecosystem Change<br>2. Assessing the Short-term Effects of Human Disturbance on Steller Sea Lion Behavior*<br>3. Zonal Management of Southern Sea Otters: An Ideal Compromise or Flirting wth Disaster?<br>4. The Sea Otter in North America: Defenders of Wildlife's Efforts in Conservation, Advocacy and Education |
| **3:30 p.m.** | **COUGARS, CORES AND CORRIDORS .....32**<br>1. Influence of Vegetation, Roads and Topography on Puma Movement<br>2. Cougar-Human Interactions: Movement Patterns and Behavior Along the Urban-Wildland Interface*<br>3. An Individual-Based Movement Approach to Evaluating Connectivity of Mountain Lions in Southern California<br>4. Designing Linkages for Pumas (and Other Species) — A Sensitivity Analysis of GIS Models*<br>5. Movements, Activity and Food Habits of Mountain Lions in A Fragmented Urban Landscape in Southern California<br>6. Panel Discussion: Managing for Connectivity | **ENVIRONMENTAL EDUCATION ON CARNIVORES.....38**<br>1. Carnivore Education: Beyond Biology<br>2. Wolves in Education Programs: Wolf Park's 32 Years of Public Education<br>3. Tricks of the Trade: Teaching About Wolves During Re- and De-Classifications<br>4. On the Edge: Neighborhood Wildlife Education in Urban Southern California<br>5. Communicating About Carnivores: Education is Key on the Urban-Wildland Frontier<br>6. Environmental Education Materials on Felids for Rural Areas in the Mexico-U.S. Border<br>7. Engaging New Audiences and Educating Those Pesky Tourists |
| **Evening** | Mountain Lion Conservation Meeting: Planning for the Future (6:00 p.m. to 8:00 p.m))<br>.....52 | Education Roundtable (6:00 p.m. to 8:00 p.m.)<br>.....52 |

# MONDAY, NOVEMBER 15

| | LA TERRAZA ROOM | OTHER CONFERENCE EVENTS |
|---|---|---|
| **8:00 a.m.** | | Registration Open, 7:30 a.m. to 5:00 p.m.<br>Exhibit Hall Open 8:00 a.m. to 5:00 p.m.,<br>New Mexico Room and Santa Fe Room<br>9:30 a.m., Coffee Break, Exhibit Hall |
| **10:00 a.m.** | **MESOCARNIVORES I.....13**<br>1. Progress Report - May 2004, Wildlife Conservation Society, Greater Yellowstone Wolverine Study<br>2. Canada Lynx and Wolverine: Five Years of Conservation<br>3. Influence of Snow Conditions on Habitat Selection by Lynx in Northern Washington<br>4. Development of a Cooperative Research Project to Study Canada Lynx in the Western Great Lakes Region<br>5. Utility of Forest Carnivores (American Marten and Lynx) As Umbrella Species for Biodiversity Conservation<br>6. Food Habits of the Red Fox, Marten and Coyote in the Lassen Peak Region of Northern California | Mission:Wolf Session I, open to ticket holders only, Coronado Room |
| **12:15 p.m.** | | Press Lunch (Stiha Room), open to credentialed press |
| **1:30 p.m.** | **MESOCARNIVORES II.....28**<br>1. The Relative Importance of Habitat Variables and Species Co-Occurrence for Predicting Mesocarnivore Species<br>2. Evaluating the Impact of Translocations on Montana Fisher Populations<br>3. The Decline of the Eastern Spotted Skunk and Results of Recent Survey Efforts in Missouri<br>4. Using Ontogenetic Data to Test Phylogenetic Environmental Hypotheses of Bulla Size in Carnivores | Mission:Wolf Session II, open to ticket holders only, Coronado Room<br><br>3:00 p.m. Coffee Break and Poster Session, Mezzanine (poster abstracts listed on pages 177-208) |
| **3:30 p.m.** | **BADGERS.....45**<br>1. Evolution of American Badger and the "Badger" Ecomorph<br>2. Ecology of a Badger Population on the Chaparral Wildlife Management Area in Southern Texas<br>3. Ecological Factors Associated with the Distribution of Badgers in the San Francisco Bay Region*<br>4. Genetic Structure of Sensitive and Endangered Northwestern Badger Populations<br>5. Life on A Highway: Sources of Mortality in an Endangered British Columbian Badger Population<br>6. Translocation as a Promising Tool to Aid Recovery of Badger Populations<br>7. Assessment of Badger Damage to Machinery and Livestock | Mission:Wolf Session III, open to ticket holders only, Coronado Room |
| **Evening** | Badger Meeting (5:30 p.m. to 7:30 p.m.).....52<br>Developing Guidelines for Fisher Reintroduction (7:30 p.m. to 10:00 p.m.) .....53 | 5:30 p.m.Canid Specialist Group Meeting (Coronado Room)<br>Jaguar Project Reception, Bishop's Lodge (Bus departs La Fonda at 5:45 p.m.) |

# TUESDAY, NOVEMBER 16

| | LUMPKINS BALLROOM SOUTH | LUMPKINS BALLROOM NORTH |
|---|---|---|
| **8:00 a.m.** | **ETHICS AND PREDATOR CONSERVATION .....54**<br>1. A Predator's Nose Under the Tent: From Science to Ethics and Back Again<br>2. Bringing Bioethics to Carnivore Conservation<br>3. Predator Paranoia and the Politics of Culling Marine Mammals<br>4. The Predator's Koan: Which Cog Turns the Wheel? | |
| **10:00 a.m.** | **CARNIVORES AND HUMANS: ATTITUDES, POLICY AND MANAGEMENT .....62**<br>1. Predator Control in Alaska: An Analysis of Current Predator Control Programs and the Recommendations of the 1997 National Research Council Report, "Wolves, Bears and Their Prey in Alaska"<br>2. Wolves: Persecution, Science and Their Intrinsic Value<br>3. Testing the Ambassador Population Hypothesis<br>4. Attitudes Toward Wildlife Management of Black Bears in Missoula, Montana*<br>5. Humans As the Key Mega-Carnivore Environmental Factor | **GRIZZLY BEARS .....67**<br>1. Grizzly Bear Recovery: A Progress Report After 23 Years<br>2. A Collaborative Science-based Approach to Grizzly Bear Conservaton in the US-Canada Transborder Area<br>3. *Bear With Us*: An Alternative Path to Grizzly Recovery in the Lower 48 States<br>4. Delineation of Population and Sub-Population Boundaries of Grizzly Bears in Southwestern Canada Using Genetic Analysis<br>5. Comparing Alternative Representations of Available Habitat and Framing Bias in Resource Selection Models*<br>6. Last Stand: The Decline And Recovery Of Alberta's Threatened Grizzly Bear |
| **12:15 p.m.** | "WOLF: An Ancient Spirit Returns," a film directed by Michael Rosen and Sharon Howard, and narrated by Peter Coyote | |
| **1:30 p.m.** | **CARNIVORE MANAGEMENT IN RECREATION AREAS.....83**<br>1. Reducing Human - Bear Conflicts in the Tahoe Basin: Conservation through Community Alliance<br>2. Managing Bears and People in the Greater Yellowstone Ecosystem: Critical Steps for Implementing Food Storage and Sanitation Efforts in National Forests<br>3. American Marten Ecology on an Alpine Ski Area<br>4. Spatial Analysis of Human Recreational Trail Use and Wildlife Movement in the Livingstone River Area, South-Western Alberta | **BLACK BEARS.....87**<br>1. Denning Ecology of American Black Bears in Western Virginia: Implications for Research and Management<br>2. Linking Resource Availability with Demography of a Black Bear Population in the Southern Appalachian Mountains<br>3. Spatial and Temporal Distribution of Black Bear - Human Conflicts in Colorado*<br>4. Investigating the Role of Social Learning in Problem Black Bears Using Genetic Relatedness Analyses |
| **3:30 p.m.** | **INNOVATIVE FUNDING APPROACHES.....95**<br>1. Finding Funding for Carnivore Conservation<br>2. Farm Bill Programs: A Tool For Carnivore Conservation<br>3. Carnivore Conservation Trust: A Model for Joint Private-Government Funding to Conserve and Manage Carnivores in North America | **PREDATOR - PREY DYNAMICS .....98**<br>1. Modeling Wolf-Moose Ecosystems Using Cellular Automata<br>2. Elk Harvest and Wolf Presence In Idaho: Is There a Link?<br>3. Wolf-Elk Interactions on State Managed Feed Grounds and Adjacent National Forests in Wyoming<br>4. Evaluating the Effects of Mexican Wolf Recovery on Elk Populations in New Mexico<br>5. Relative Contributions of Prey Physical Condition and Habitat Structure to Predation by Cougars and Wolves in Southwestern Montana<br>6. Cascading Effects of Subsidized Mountain Lion Populations in the Chihuahuan Desert |
| **7:00 p.m.** | Banquet, with featured speaker Levi Holt ) .....112 | |

# TUESDAY, NOVEMBER 16

| | LA TERRAZA ROOM | OTHER CONFERENCE EVENTS |
|---|---|---|
| **8:00 a.m.** | **BLACK-FOOTED FERRET RECOVERY.....58**<br>1. Biomedical Survey of Wild Black-Footed Ferrets<br>2. Reintroduction of the Black-Footed Ferret at the Southern Limit of the Black-Tailed Prairie Dog Distribution<br>3. The Effect of Prairie Dog Density and Owl Predation on Survival of Reintroduced Black-Footed Ferrets<br>4. Selection of Prairie Dog Colonies by Black-Footed Ferrets in South Dakota | Registration Open, 7:30 a.m. to 5:00 p.m.<br>Exhibit Hall Open 8:00 a.m. to 5:00 p.m., New Mexico Room and Santa Fe Room<br>9:30 a.m., Coffee Break, Exhibit Hall<br>10:00 a.m. Mission:Wolf Session IV, open to ticket holders only, Coronado Room |
| **10:00 a.m.** | **ECONOMICS OF CARNIVORE CONSERVATION.....73**<br>1. The Role of Economics in the Recovery and Conservation of Endangered Species and Their Habitats<br>2. Economic Benefits to California Residents of the Southern Sea Otters<br>3. Economic Impacts of Designating Critical Habitat for Lynx<br>4. Red Wolves: Creating Economic Opportunity Through Ecotourism in Rural North Carolina<br>5. Spending on Recovery: Compensation Costs for Livestock Depredation by Gray Wolf in the Northern Rockies | **WILDLIFE GENETICS, STIHA ROOM.....78**<br>1. The Importance Of Genetics For Managing Carnivores<br>2. Hybridization in Threatened and Endangered Carnivores<br>3. Recent History And Connectivity Of Cougar Populations: Can A Virus Tell The Story?<br>4. Methods to Identify and Remove Genotyping Errors From Non-Invasively Collected Genetic Tags<br>5. Reintroduction History Affects Genetic Diversity and Morphology of the Black-Footed Ferret |
| **12:15** | | |
| **1:30 p.m.** | **CARNIVORES OUT OF PLACE.....91**<br>1. Effect of Golden Eagle Removal on Survivorship of Island Foxes<br>2. The Impact of Introduced Red Foxes on Australian Mammals in Jervis Bay<br>3. Adaptive Experimental Management of the Introduced Red Fox to Protect Biodiversity<br>4. Competition in an Alien World: Translocated Mustelids in New Zealand | 1:30 p.m. Mission:Wolf Session V, open to ticket holders only, Coronado Room<br>3:00 p.m. Coffee Break and Poster Session, Mezzanine (poster abstracts listed on pages 177-208) |
| **3:30 p.m.** | **URBAN CARNIVORES.....104**<br>1. Death and Disease in the City: Disease Dynamics Among Urban Mesocarnivores<br>2. The Ecology of Eastern Coyotes on Urbanized Cape Cod<br>3. Influence of Urbanization on Bobcat and Coyote Diets in Southern California<br>4. Social Structure, Genetic Relatedness and Reproduction in Urban Southern California Bobcats<br>5. Ringtailed-cat Home Range Within Mexico City<br>6. Spatial Use of a Suburban Carnivore: The Gray Fox in Mexico City<br>7. Ringtail Scent-Marking With Feces | 3:30 p.m. Mission:Wolf Session VI, open to ticket holders only, Coronado Room |
| **Evening** | | 5:30- 7:00 Silent Auction and Booksigning, Mezzanine Wednesday, November 17 |

| | LUMPKINS BALLROOM SOUTH | LUMPKINS BALLROOM NORTH |
|---|---|---|
| **8:00 a.m.** | **WOLF RECOVERY .....113**<br>1. Restoration of the Gray Wolf in the Northwestern United States<br>2. Preliminary Results: Status of Red Wolves in Northeastern North Carolina After Five Years of Adaptive Management and 17 Years of Experimental Restoration<br>3. Crafting Effective Recovery Strategies for Wolves in the U.S. Using Dynamic Models<br>4. If We Plan It, Will They Come? Planning for Wolves in Oregon<br>5. Securing a Future for Gray Wolf Recovery in the Northeastern U.S. | **CARNIVORES AND HIGHWAYS .....118**<br>1. North America's Most Critical Highways for Carnivore Conservation<br>2. Carnivores, Roads and Habitat Permeability in the Canadian Rocky Mountains: A Community Level Study<br>3. A Coarse Monitoring Approach to Wildlife Distribution and Fragmentation Based on Human Highways<br>4. Innovative Partnerships that Address Highway Impacts to Wildlife Connectivity in the Northern Rockies |
| **10:00 a.m.** | **MEXICAN WOLF RECOVERY .....126**<br>1. Return of the Mexican Gray Wolf: Back to the Blue<br>2. Rewilding the Southern Rockies<br>3. Fate of the Mexican Wolf Teeters Between Science and Politics<br>4. Potential Areas for Wolf Reintroduction in Mexico<br>5. Mexican Gray Wolves: Challenges for the Captive Breeding Program in 2004<br>6. Sperm Quality in Mexican Wolves and Island Foxes: Relationship to Genetic Management | **HABITAT FRAGMENTATION AND LINKAGES ...132**<br>1. Human Influences on Range Contractions of North American Carnivores and Ungulates<br>2. Scale-Dependent Habitat Associations Within and Among Carnivores and Prey in the Canadian Rocky Mountains<br>3. Threats to Wildlife Linkages in the New Mexico Highlands and Sky Islands Wildlands Networks<br>4. Jaguar Habitat Models and Their Utility in Conservation*<br>5. Designing an Ecological Network for Large Carnivore Protection in Vrancea County, Romania |
| **1:30 p.m.** | **WOLF ECOLOGY.....144**<br>1. Linking Plant Growth to Wolf Reintroduction in Yellowstone National Park<br>2. Wolf Den Site Selection and Characteristics in the Northern Rocky Mountains*<br>3. Modeling Gray Wolf Distribution and Resource Selection in Coastal Temperate Rainforests of British Columbia, Canada*<br>4. Temporal Predictability of Depredation on Livestock and Wolf Control in Western North America | **RARE CARNIVORE RECOVERY .....148**<br>1. Border Cats of the Sky Islands: A Summary of Research and Detection Efforts Using Noninvasive Techniques<br>2. Restoring Wolves to the Grand Canyon<br>3. Cumulative Impacts and Mitigation Failure in Florida Panther Recovery<br>4. Black-Footed Ferret Recovery: Lessons and Future Directions<br>5. Living With Wildlife at the Urban Interface |
| **3:30 p.m.** | **WOLVES & LIVESTOCK .....157**<br>1. Introducing Non-lethal Deterrents to Livestock Depredations in Southwestern Alberta<br>2. Assessing Factors Related to Wolf Depredation of Cattle in Montana and Idaho*<br>3. The Nature of the Beast: Wolf Conflicts and Conservation in the Northern Rockies<br>4. Predicting the Geography of Potential Wolf Livestock Conflict in Utah: A GIS-Based Approach to Proactive Depredation Management<br>5. Experimental Assessment of a Non-lethal Control Method for Reducing Wolf-Human Conflict*<br>6.Grazing Retirement: An Important New Approach to Large Carnivore Conservation<br>7. Integrating Livestock Husbandry and Large Carnivore Biology | **REMOTE CAMERA SURVEYS IN CARNIVORE RESEARCH .....164**<br>1. A Comparison of Non-Invasive Techniques for Detecting Three Forest Carnivores: Conservation Detector Dogs, Remote Cameras, and Hair Snares<br>2. Ocelot Home Range and Density in Belize<br>3. Use of Remote Cameras and Mark-Recapture Statistics to Estimate Puma Densities in Central America<br>4. Monitoring Jaguar Populations Using Camera Traps: Abundance Surveys in Belize<br>5. Monitoring the Behavior of an Elusive Carnivore with Remote Camera Systems: Folly or Panacea?*<br>6. Forest Carnivore Camera Surveys in Northern California: Lessons Learned from Methodology and Results<br>7. The Importance of "Gravy Data": Getting the Most Out of your Photosurvey Effort |

| | LA TERRAZA ROOM | OTHER CONFERENCE EVENTS |
|---|---|---|
| **8:00 a.m.** | **KIT FOXES .....122**<br>1. Effects of Habitat Attributes on Competition Between Endangered San Joaquin Kit Foxes and Coyotes*<br>2. Artificial Dens as a Conservation Tool for Endangered San Joaquin Kit Foxes<br>3. Mortality and Home Range of the Kit Fox<br>4. An Assessment of Hair Trap Designs: Removing the Ambiguity of Non-Invasive DNA Sampling from Individuals | Registration Open, 7:30 a.m. to 12:00 p.m.<br>Exhibit Hall Open 8:00 a.m. to 3:30 p.m., New Mexico Room and Santa Fe Room<br>9:30 a.m., Coffee Break, Exhibit Hall |
| **10:00 a.m.** | **CENTRAL & SOUTH AMERICAN CARNIVORES .....137**<br>1. Human and Predator Conflicts in Brazil: An Overview of the Last Decade of Problems and Solutions<br>2. Saving the Jaguar: A Model for the Long-Term Conservation of the World's Third Largest Cat<br>3. Impacts of Subsistence Hunting on the Foraging Ecology of Jaguar and Puma in the Maya Biosphere Reserve, Guatemala<br>4. Telemetric Studies of Ocelot-Agouti Predator-Prey Interactions<br>5. Concentrations of Testosterone and Stress Levels Using Fecal Steroids in a Wild Population of Coyotes<br>6. The Natural History of the Little Spotted Cat in Brazil: Preliminary Report<br>7. Predators and Their Habitats Revisited: A Diverse Carnivore Community and Their Habitat Associations in the Atlantic Forest of Paraguay | |
| **1:30 p.m.** | **RAPTOR CONSERVATION .....153**<br>1. Urban Raptors: Mitigating Threats from Electrocution and Imprinting on Humans<br>2. Foraging Patterns of Reintroduced California Condors in the Grand Canyon Ecoregion<br>3. Breeding Effort and Parental Care in Reintroduced California Condors<br>4. The Northern Aplomado Falcon and Implications for Reintroduction Policy | 3:00 p.m., Coffee break, Mezzanine |
| **3:30 p.m.** | **AFRICAN CARNIVORES.....171**<br>1. Establishing Conservation and Research Priorities for African Carnivores<br>2. Social Structure of the World's Most Endangered Canid, the Ethiopian Wolf, Elucidated by Genetic Methods<br>3. Building Partnerships: Culture-Based Wild Dog Conservation in Southern Kenya<br>4. Livestock Predation by Lions and Other Carnivores on Ranches Neighboring the Tsavo National Parks, Kenya<br>5. Reintroducing the African Lion in South Africa: Short-Term Success but Is It Conservation?<br>6. Competititve Exclusion of Endemic Predators by Invasive Domestic Carnivores in Madagascar | |

# General Information

## Conference Registration

All attendees and participants must register for the conference. Anyone not wearing a conference nametag may not be admitted to conference meetings and functions. Spouses and children of registered attendees who wish to attend must register. Media (with credentials) must register, but may do so free of charge. On-site registration fees are as follows:

**Defenders of Wildlife Member:** $205
**Non-member:** $225
**Full-time student**: $205
**One-day**: $100
**Field trip to Bandelier National Monument:** $40
**Tuesday Night Banquet:** $40
**Defenders of Wildlife membership:** $15 (special conference offer)

## Conference Registration Desk

Attendees should check in at the registration desk upon arrival at the La Fonda to pick up their registration packet. This packet includes their name tag, which will admit them to conference functions, as well as conference program and tickets for the field trip, banquet and wolf sessions. Information and a message board will also be available at the registration desk. Registration desk hours are as follows:

Sunday, November 14: 8:00 a.m. to 7:00 p.m.
Monday, November 15: 7:00 a.m. to 6:00 p.m.
Tuesday, November 16: 7:30 a.m. to 5:00 p.m.
Wednesday, November 17: 7:30 a.m. to noon

## Conference Personnel

Defenders of Wildlife staff will have green ribbons on their nametags and any staff member can provide assistance or answer questions. The following are the lead staff for various aspects of the conference:

**Aimee Delach and Nina Fascione**—Program, Facilities, Volunteers
**Corrine Salin**—Registration
**Susi Mattheisen, Sarah Humphries**—Member Services
**Caroline Kennedy**—Field Trip
**Lisa Hummon**—Exhibit Hall
**Gina Schrader**—Silent Auction and Banquet
**Wil Lutz and Brad DeVries**—Media

## Notice to Speakers and Poster Presenters

In order to ensure a fair time allotment for all speakers, moderators have been instructed to adhere to the time schedule. Please complete your presentation in the designated time allowed so as not to shortchange other speakers or interfere with other conference activities.

Speakers who are using PowerPoint presentations are required to submit their presentations on a CD or a Zip (100 or 250) disk or USB device to the registration desk at least 3 hours prior to their session.
Speakers who are using slides are urged to bring them presorted in a standard carousel, and to check for proper slide positioning prior to your session. The La Fonda Boardroom will be available to speakers as a preparation room from 9 a.m. to 7 p.m. on Sunday, 7:30 a.m. to 9:30 p.m. on Monday and 7:30 a.m. to 5:30 p.m. on Tuesday. It will have a slide projector set up.

Speakers and moderators should also arrive at their assigned rooms 30 minutes before the start of their session for a final check of audiovisual materials.

Posters should be set up in the Mezzanine between noon and 7 p.m. on Sunday and must be removed by noon on Wednesday. Velcro and thumb tacks will be provided.

## Santa Fe Area

Santa Fe is unique in history, culture, art, architecture and just about every other respect imaginable! Many of the city's museums, restaurants, art galleries, shops theaters, and historic attractions are located within walking distance of the hotels we have chosen for Carnivores 2004. For more information, please consult the Santa Fe Visitor's Guide in your conference packet.

With all that there is to do, it is important to remember that Santa Fe is a high desert locale! All visitors, especially those from lower altitudes, should make sure to:

- Take it easy the first few days, to get acclimated to the altitude
- Drink plenty of water
- Use sunscreen and a hat to protect from sunburn, which occurs more quickly at high altitudes
- If you are planning to hike or climb mountains, know the symptoms of altitude sickness and pul-

monary edema, and observe all standard safety precautions for backcountry travel.

November weather in Santa Fe generally consists of average highs around 50ºF and lows around 30ºF. Rain or snow is possible. The dress code for the conference is business casual, including for evening events. In general, the same holds true for the city of Santa Fe.

## STUDENT COMPETITION

Papers marked with an asterisk (*) in the conference program are competing for best paper or poster by a high school, undergraduate or Master's student. Student talks and posters will be judged by a panel of experts from the Society for Conservation Biology. Winners will receive a cash prize and will be acknowledged on the Carnivores 2004 website.

## AMBASSADOR WOLF WORKSHOPS

Mission:Wolf, based in Colorado, will bring ambassador wolves for six small-group programs to allow attendees an up-close look at live wolves. The programs will provide information on basic wolf biology and behavior and offer a unique opportunity to interact one-on-one with wolves. There is no cost for this workshop, but space is limited to the first 200 conference registrants who enroll. Tickets to an assigned session are included in your registration packet and are not transferable to any other session.

## EXHIBITORS

Please visit our exhibit hall, in the New Mexico Room and Santa Fe Room. The hall will be open Monday and Tuesday from 8:00 a.m. to 5:00 p.m. and Wednesday from 8:00 a.m. to 3:30 p.m.

**Academia Book Exhibits**
3512 Willow Green Court
Oakton, VA 22124
http://www.acadbkex.com/

**Defenders of Wildlife**
1130 17th Street NW
Washington, DC 20036
www.defenders.org

**Endangered Species Coalition**
2063 Placita de Vida
Santa Fe, NM 87505
www.stopextinction.org

**Enhydra lutris Nature Photography**
45718 Shadow Mountain Drive
Palm Desert, CA 92260

**International Fund for Animal Welfare**
1474 Gordon Street
Guelph, Ontario N1L 1C8
Canada
www.ifaw.org

**International Wolf Center**
12615 Co. Road 9, #200
Minneapolis, MN 55441
www.wolf.org

**Island Press**
1718 Connecticut Ave NW, Suite 300
Washington, DC 20009
www.islandpress.org

**Lotek Wireless, Inc.**
115 Pony Drive
New Market, Ontario L0G 1V0
Canada
www.lotek.com

**Mountain Lion Foundation**
926 J Street, Suite 803
Sacramento, CA 95814
www.mountainlion.org

**H. Steven Logsdon (art and jewelry)**
P.O. Box 4070
Silver City, NM 88062
505-388-8101

**Steve Oliver Art**
5200 Hilltop Drive CC-2
Brookhaven, PA 19015
www.steveoliverart.com

**Pack Leader Detector Dogs**
14401 Crews Road, KPN
Gig Harbor, WA 98329
www.packleaderdogtraining.net

## EXHIBITORS (CONTINUED)

**Prairie Wildlife Research**
P.O. Box 515
Wall, SD 57790
www.prairiewildlife.org

**Predator Conservation Alliance**
P.O. Box 6733
Bozeman, MT 59771
www.predatorconservation.org

**Prescott College**
220 Grove Avenue
Prescott, AZ 86301
www.prescott.edu

**Red Wolf Coalition**
Post Office Box 2318
Kill Devil Hills, NC 27948
www.redwolves.com

**Sierra Club**
408 C Street, NW
Washington, DC 2002
www.sierraclub.org

**Society for Conservation Biology**
4245 N. Fairfax Drive
Arlington, VA 22203
www.conbio.org

**Southwest Environmental Center**
275 North Downtown Mall
Las Cruces, NM 88001
www.wildmesquite.org

**Wolf Education and Research Center**
111 Mains Street, Room 150
Lewiston, ID 83501
www.wolfcenter.org

**Wolf Park**
4004 East 800 North
Battle Ground, IN 47920
www.wolfpark.org

## SCIENTIFIC ADVISORY COMMITTEE

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**Bernd Würsig**
Texas A&M University

**Gerald Zuercher**
University of Dubuque

# PLENARY SESSION

Gloria Flora works to ensure sustainability of public lands and the plant, animal and human communities that depend on them through her non-profit organization, Sustainable Obtainable Solutions (SOS). She contributes meaningfully to the dialogue on natural resource management, focusing on the principles of conservation biology, the value of people's relationship to their landscapes and ensuring the sustainability of those landscapes. For over 22 years, she attempted to do that with the U.S. Forest Service working primarily in the Intermountain West. Before resigning, she served as a Forest Supervisor in north-central Montana and in Nevada and eastern California.

Well-known for her leadership in ecosystem management and public involvement, she made a landmark decision to prohibit oil and gas leasing from the Rocky Mountain Front in Montana. She later resigned from the Forest Service to call national attention to persistent anti-federalist activities in Nevada, which included harassment of public land managers and their families and wanton ecological destruction of aquatic and range habitats.

SOS works with other non-profits on sustainability issues, currently emphasizing protection of the Rocky Mountain Front and other areas across the West from inappropriate energy development. In partnership with Champion Tree Project Int'l., she works to preserve the genetics of the largest and oldest trees of every species. With Champion Tree Project, SOS is creating living archival libraries of champion clones and reintroducing ancient genetics into community and urban forests.

Gloria earned a B.S. in Landscape Architecture from Pennsylvania State University which has honored her with a Distinguished Alumnus Award. Among her other awards are: the Murie Award for courageous stewardship of public lands (The Wilderness Society), the Environmental Quality Award for exemplary resource decisionmaking (Natural Resources Council of America), American Fisheries Society Individual Service Award, the Giraffe Foundation Award (for sticking her neck out), Sunset Magazine's Environmental Hero Award and an outstanding performance award for her work in Nevada (U.S. Forest Service). Her work has been highlighted in *Public Integrity: Exemplar Series* of the American Society of Public Administrators, PBS's NOW with Bill Moyers, in magazines such as *Audubon*, *Orion*, and *Forest* and other media.

Gloria serves on the Boards of Directors for the Oil and Gas Accountability Project, Women's Voices for the Earth and Defenders of Wildlife, and on the Advisory Board of Backcountry Hunters and Anglers.

# MOUNTAIN LION CONSERVATION I

*Moderator: Lynn Sadler*

## 1. Identifying Human-Caused Mortality Hotspots in the American West

CHRISTOPHER PAPOUCHIS[1] AND TIM DUNBAR[1]

Mountain lions *(Puma concolor)* remain the sole large carnivore with viable populations throughout much of the American West, and play an important role in maintaining the integrity and diversity of a variety of ecosystems. Since the management of mountain lions by state agencies is undertaken primarily through the regulation of mortality, conserving mountain lion populations throughout their range requires a detailed understanding of mortality trends. In recent decades, growing interest in mountain lions as a trophy game species and apparently increasing conflicts between mountain lions and livestock, pets and humans, have led to a rapid escalation in human-caused mortality. As a result, the number of mountain lions killed by humans in recent years has reached the highest levels reported since 1900 in nearly all the Western U.S. states. We compiled mortality data provided by state wildlife agencies by type (e.g. sport hunting, depredation, public safety, and unspecified) and report on mountain lion mortality trends in 11 western states, with a focus on the ten year period from 1992 to 2001. Moreover, because state and management units differ markedly in size and amount of suitable mountain lion habitat, we utilized available projections of mountain lion habitat and estimated the number of kills per 100 square miles of suitable mountain lion habitat to standardize kill rates. We then compared these densities of kills to identify which geographic areas within the 11 western states have the greatest concentrations of human-caused mortality. Finally, we provide several recommendations based on our findings.

[1]Mountain Lion Foundation, P.O. Box 1896, Sacramento, CA 95816, cpapouchis@mountainlion.org

# 2. Ensuring Public Safety and Cougar Persistence Through Science and Education: Project CAT and Cougar Awareness

GARY KOEHLER[1] AND ROCKY SPENCER[2]

Conflicts between wildlife and humans are increasing throughout western North America as rural landscapes become urbanized. In the past decade the population of Washington State has increased by greater than a million people and each year approximately 70,000 acres of wildlife habitat is lost to development. As elsewhere in the West, this growth and expansion is met with increased incidence of cougar-human interactions. To help ensure the safety of the public and ensure a place for cougars as an integral part of the landscape, the Washington Department of Fish and Wildlife and Cle Elum-Roslyn School District's program, Project C.A.T. (Cougars and Teaching), links wildlife research scientists with public school students and teachers and community members in a experiential learning and education outreach program of Cougar Awareness. Students and community members collect and analyze data of movements for cougars marked with GPS collars. An understanding of the behavior and ecology of cougars among this and neighboring communities empowers community members to weigh the spatial and habitat needs of cougars with the residential and recreational needs and desires of humans. Science as an education tool is helping to unveil the cougars' mystique as a member of the ecological community. Student and community participation in these scientific findings assures the public's investment in this knowledge and provides a progressive foundation of knowledge and Cougar Awareness leading to increased public safety and acceptance of cougars among their communities.

[1]Washington Department of Fish and Wildlife, P.O. Box 102, Cle Elum, WA 98922, koehlgmk@dfw.wa.gov

[2]Washington Department of Fish and Wildlife, 42404 North Bend Way SE, North Bend, WA 98045

# 3. Puma-Human Interactions in Cuyamaca Rancho State Park, Southern California

LINDA L. SWEANOR[1], KENNETH A. LOGAN[2], JIM W. BAUER[3], BLUE MILSAP[4] AND WALTER M. BOYCE[5]

We studied puma *(Puma concolor)* locations and movements in relation to human activity in Cuyamaca Rancho State Park (CRSP) in southern California. From January 2001 through December 2003 we studied 17 pumas (13 adults, 1 subadult, 3 cubs) and placed GPS radiocollars on 12 adults. Ten of the 17 pumas died; 5 deaths were human-caused. Each of 8 pumas that utilized CRSP also used areas comprising 17-43% private lands. Pumas and people exhibited temporal separation in their activity. Pumas were most active during night and crepuscular periods, whereas most visitor use of trails (mean = 85%) occurred during the day. Pumas did not use vegetation types in relation to their availability, avoiding chaparral during crepuscular and night periods, and grass cover during the day. Edge habitats were important to females (all time periods) and males (night). Fewer puma locations than expected ($P < 0.001$) were within 100 m of trails during the day, but not at night, suggesting pumas may have been temporally avoiding human activity areas. Pumas were also rarely (0.6% of 1,069 locations) within 100 m of park facilities, and then only at night or during crepuscular periods. People living near or recreating in CRSP may be at risk of a negative encounter with a CRSP puma; human activity and behavior outside CRSP may also affect the survival of CRSP pumas. Education, land use planning, and continued puma monitoring may best minimize the chance of conflicts and provide the best chance for a continued puma presence in the ecosystem.

[1]University of California, Field Office, 68761 Overland Drive, Montrose, CO 81401, lsweanor@mindspring.com

[2]Colorado Division of Wildlife, 2300 S. Townsend, Montrose, CO 81401

[3]University of California, Field Address, P.O. Box 1203, Julian, CA 92036

4USDA-Wildlife Services, 3419A Arden Way, Sacramento, CA 95825

5University of California, Wildlife Health Center, One Shields Ave., University of California, Davis, CA 95616

# 4. 4H and FFA's Livestock Depredation Reduction Efforts

LYNN MICHELLE CULLENS[1]

When the last male mountain lion (*Puma concolor*)in the Santa Monica Mountains of Southern California made a meal of several domestic goats, the landowner requested that a depredation permit be issued to hunt the lion. Immediate media attention and public outcry caused the landowner to stop the hunt. But high on a hill, overlooking the beaches of Malibu and the skyline of Los Angeles, his livestock continued to be eaten while scientists, conservationists, agencies and agricultural advisors pondered the problem. Students in the 4H and FFA chapters in the San Fernando Valley, recognized that most lions killed in California for livestock depredation are killed because they have preyed on hobby or "project" animals. Under the direction of advisor Joey Nakasone, they had already planned to assemble a low-cost lion-proof enclosure in the area as a demonstration project for small livestock owners. But environmental law, particularly in the zone regulated by the California Coastal Commission, restricts construction activities. We present what we learned as a result of these events, and how small-scale efforts to improve animal husbandry may affect broad statewide carnivore conservation policy.

[1]Mountain Lion Foundation, P.O. Box 1896, Sacramento, CA 95816, cullens@mountainlion.org

# 5. A New Paradigm for Mountain Lion Conservation and "Management" in the 21st Century

RICK HOPKINS[1] AND CHRISTOPHER M. PAPOUCHIS[2]

Teddy Roosevelt admonished more than a century ago, "no American beast has been the subject of so much loose writing or of such wild fables as the cougar." During the last century we have moved from a society that considered cougars (*Puma concolor*) to be vermin and sought their eradication to one that recognizes their invaluable ecological role and seeks to ensure their survival. However, in the end we believe that cougars remain viable through much of the Western U.S. and Canada not because of insightful management over the last three decades, but due more to fact we failed in our mission to eradicate them in the early to mid-1900s. Today, our management of this charismatic carnivore remains based more on unproven assumptions than on hard scientific data. In 2001, Ken Logan and Linda Sweanor wrote in *Desert Puma* that cougar "hunting management in most western states is a far cry from science." Here we explore two myths (or wild fables) that have permeated the literature and, in our view, affect our management of the species. These are: 1) sport-hunting has been a necessary and effective tool for managing the cougar; and 2) cougars are losing their fear of humans and posing greater risk to us then in previous decades. The pervasiveness of these myths guarantees that the debate surrounding cougars will remain disproportionately focused on issues that contribute to the polarization of ideas, complicating efforts to inform public policy and ultimately lending little to the long-term conservation of cougars in the West.

[1]Cougar Fund and Live Oak Associates, 6830 Via Del Oro, Suite 205, San Jose, CA 95119, rhopkins@loainc.com

[2]Mountain Lion Foundation, P.O. Box 1896, Sacramento, CA 95816

# PARTNERSHIPS IN RESEARCH AND CONSERVATION

*Moderator: Scotty Johnson*

## 1. AZA Partnerships: 135 Million Person Audience and $7 Million in Funding

MARGO M. MCKNIGHT[1] AND TONY VECCHIO[2]

The American Zoo and Aquarium Association (AZA) has 217 member institutions, 135 million visitors, and collective annual operating budget of approximately 1.2 billion dollars. In the last 20 years the conservation focus has turned slowly from *ex situ* to *in situ* and more dollars every year are being funneled to field projects. In 2003 approximately $7 million was granted in support of *in situ* projects. A strong movement within the Association is pushing hard for the field support component to grow larger and more quickly. A growing number of zoos and aquariums, both large and small, are providing annual grants for field projects usually entailing a relatively streamlined application process. A far larger number of institutions provide financial support, equipment, expertise and educational materials to field projects. The importance of carnivores to zoo and aquarium collections stretches far beyond their ecological value. These compelling animals are powerful educational tools, fund-raising and marketing icons. Potentially the most powerful role AZA institutions can play in conservation is the ability to reach the general public in a way not available to most other conservation organizations. Although many great partnerships between AZA institutions and conservation organization/agencies have been formed, many more opportunities are available.

[1]Brevard Zoo, 4250 Skyway Drive, Cocoa, FL 32927, MargoMcKnight@aol.com

[2]Oregon Zoo, 4001SW Canyon Road, Portland, OR 97221

# 2. A Zoo's Role in the Multi-Institutional Island Fox Recovery Effort

WENDY STANFORD1 AND ALAN VARSIK[1]

Island Fox (*Urocyon littoralis*) populations in the Channel Islands National Park declined to near extinction in the late 1990s. In response to this, the National Park Service brought foxes into a captive breeding program, which has since grown into a multi-institutional partnership aimed at the recovery of the island fox on the California Channel Islands. The Santa Barbara Zoo has been involved in this collaborative conservation effort since 1999, through the Zoo's Island Fox Conservation Program. The goals of this program are to provide assistance and support to the field effort, while working *ex-situ* to increase public awareness and support for island fox conservation. The assistance we provide to the *in-situ* effort is in the form of husbandry and veterinary staffing, medical equipment, and sharing of captive husbandry practices. The Zoo's *ex-situ* efforts include conducting independent and collaborative behavioral studies of the fox, and gathering physiological data for other associated studies to enhance the management of fox populations. The Zoo has also developed a strong public education program focused on the conservation need of the Island Fox. Two (2001 and 2003) Island Fox Husbandry Workshops facilitated by the Zoo have served to consolidate and expand the understanding of the husbandry and management needs of the Island Fox. This partnership has proved to be greatly beneficial to all involved, and we hope that it will provide another example for similar partnerships between the American Zoo and Aquarium Association and federal, state, and non-profit institutions working towards conservation in the wild.

[1]Santa Barbara Zoo, 500 Ninos Drive, Santa Barbara, CA 93103, wstanford@sbzoo.org

# 3. AZA Zoo Professionals Assist with Brown Bear Field Study

LISA TRYON[1] AND STACEY JOHNSON[2]

The Bear Taxon Advisory Group of the American Zoo and Aquarium Association is partnering with the Alaska Department of Fish and Game to do a summer-long study of brown bears (*Ursus arctos*) on the Kenai and Alaska Peninsula. Over 68 zoo keepers from 47 zoos are participating in this study to determine the effects of humans on brown bears at Alaskan salmon streams. Groups of five keepers at a time will arrive at the base camp by float plane to spend a week observing the bears. This presentation will represent our experiences in field.

[1]AZA Bear Taxon Advisory Group, 125 Springdale Street, Bridgeport, CT 06606, arklos@aol.com

[2]Fort Worth Zoo, 1989 Colonial Parkway, Fort Worth, TX 76110

# 4. Linking In-Situ and Ex-Situ Conservation Efforts: An Essential Strategy With the Bush Dog

KAREN E. DEMATTEO[1]

*Ex-situ* or captive breeding programs have become an essential component of success for in-situ conservation efforts in many ways. With rare and elusive species, gaining insight into their basic biology and ecology requires combining knowledge gained in both captive and field studies. Recent research at the Saint Louis Zoo (St. Louis, Missouri - USA) with the bush dog (*Speothos venaticus*), a small and poorly understood canid from central and South America, is a perfect example of how these two efforts can been linked for the species' benefit. First, outstanding questions about the female bush dog's reproductive physiology, a biological parameter that is difficult to understand *in-situ*, were clarified. Second, knowledge gained from captive research on bush dog olfactory and auditory communication was used to develop a field technique that could increase the probability of locating and thereby studying bush dogs in the wild. And third, radio collars were tested and modified under a controlled situation in order to ensure that the design was both safe and reliable before using them in the field. These latter two projects will provide researchers with the tools to complete the critical first step of an ecological study: locating and marking research subjects.

[1]Saint Louis Zoo, 1 Government Drive, St. Louis, MO 63110, KDeMatteo@aol.com

# 5. Use of Citizen Science in Carnivore and Mammal Research*

DAVID P. WAIDLER[1]

The engagement of everyday citizens in the process of scientific research involves many benefits as well as disadvantages. The Mammal Activity Survey at the Lewisville Lake Environmental Learning Area (LLELA) in north Texas exemplifies the evolution of such an effort. Under the direction of Dr. Jane Packard of Texas A&M University, the LLELA Mammal Activity Survey sought to determine seasonal movements of the preserve's many mammals as they transition between various habitat types. Enlisting volunteer wildlife trackers provided the study with a low-cost labor source. Questions regarding the reliability of data were helped by utilizing Cybertracker, a Palm/GPS based software program that allows for sequential collection and pinpoint accuracy of mapped data points. During weekend tracking sessions, volunteers scour the LLELA property recording mammal tracks, scat, burrows, and other indications into the cybertracker computer. Questions regarding the integrity of the research or its findings may arise when non-scientists are involved in data collection. When public policy is to be determined, the merits of using citizens will most certainly be called into question. However, through the LLELA study, it has been determined that citizen science is a worthwhile pursuit in that it provides members of the public with the opportunity to interact with the scientific community and for researchers to impact not only the creatures they study but those who may share an affinity for wildlife. For further information please visit: http://www.ias.unt.edu/llela/waidlerproposal.pdf.

[1]Texas A&M University, 9347 Highedge Circle, Dallas, TX 75238, dwaidler@mailbmc.com

*student competition

# 6. Working With Local Communities To Resolve Conflicts With Endangered African Wild Dogs

ROSIE WOODROFFE[1]

Conflict with people is the single greatest threat to large carnivores globally, and livestock depredation is arguably the most important cause of such conflict. Resolving such conflicts demands insights into the true impact of predators on human livelihoods, as well as the development of low-tech measures to reduce these costs. Local communities are most likely to accept estimates of predator impact under different management scenarios if they have been closely involved in the process of data collection. Working closely with Masai, Samburu and Pokot communities in northern Kenya revealed that endangered African wild dogs (*Lycaon pictus*) rarely kill livestock where wild prey are available, and where livestock are carefully herded. These findings are potentially extremely important in identifying areas where wild dogs may be able to persist, or recover, outside state protected areas.

[1]University of California, Department of Wildlife, Fish & Conservation Biology, 1 Shields Avenue, Davis, CA 95616, rwoodroffe@ucdavis.edu

# MESOCARNIVORES I

*Moderator: Cynthia Wilkerson*

## 1. Progress Report — May 2004, Wildlife Conservation Society, Greater Yellowstone Wolverine Study

ROBERT M. INMAN[1], KRISTINE H. INMAN[1], CRAIG R. GROVES[2] AND ANTHONY J. MCCUE[1]

Wolverine (*Gulo gulo*) population status in the contiguous U.S. remains uncertain and ecological requirements are not well described. Managers need scientific data to inform and substantiate decisions on endangerment status, trapping regulations, and impacts from snowmobile use. Between 2000 and 2004, we captured 19 wolverines at two study sites in the Yellowstone Ecosystem. Mean 100% MCP home range size was 754 $km^2$ for adult females (3 wolverines, 202 locations) and 910 $km^2$ for adult males (5 wolverines, 231 locations). Eight wolverines were fit with GPS or satellite collars and success of collars was variable. One dispersing male made exploratory movements between 11-46 months of age (at which time he died) into at least 8 mountain ranges and 9 political jurisdictions; 251 locations yielded a 100% MCP estimate of 37,638 $km^2$. Six mortalities included avalanche, road-kill, trapper-harvest, and inter-specific competition. Two natal den sites have been located; elevations were 7600 and 8000 feet; both were associated with downed logs under $>1$ m of snow, northern aspects, and wilderness designation. Reproduction has been confirmed in two cases. Peak snowmobile activity occurred between 11:00-15:00 hours and use levels differed between weekdays and weekends ($P \leq 0.005$). We surveyed 5,582 $km^2$ for distribution of snowmobile use and study sites varied in amount of area that was highly impacted (11% vs. 1%).

[1]Wildlife Conservation Society, 4 Trail Creek, Ennis, MT 59729, binman@wcs.org

[2]Wildlife Conservation Society, 2023 Stadium Drive, Suite 1A, Bozeman, MT 59715

# 2. Canada Lynx and Wolverine: Five Years of Conservation

JAMES J. CLAAR[1], LORI NORDSTROM[2], ROBERT NANEY[3], NANCY WARREN[4] AND STEPHEN MIGHTON[5]

We will discuss management and status of Canada lynx (*Lynx canadensis*) and wolverine (*Gulo gulo*), since the March, 2000 federal listing of lynx. Under guidance from the Interagency Steering Committee, state and federal agencies have proceeded with a chartered conservation approach for both species in the lower 48 states. We will critique this process in relation to species status, ongoing management programs, and research. Potential threats and future conservation needs for both species and habitats will be presented.

[1]USDA Forest Service, PO Box 7669, 200 East Broadway, Missoula, MT 59807, jclaar@fs.fed.us

[2]U.S. Fish and Wildlife Service, 100 North Park, Suite 320, Helena, MT 59601

[3]USDA Forest Service, Okanogan National Forest, Okanogan, WA 98840

[4]USDA Forest Service, PO Box 25127, Lakewood, CO 80225

[5]USDA Forest Service, 310 W. Wisconsin Ave., Milwaukee, WI 53203

# 3. Influence of Snow Conditions on Habitat Selection by Lynx in Northern Washington

KEITH B. AUBRY[1], JEFF VON KIENAST[2] AND GARY KOEHLER[3]

We studied winter habitat selection by Canada lynx (*Lynx canadensis*) in the northeastern Cascade Range in Washington using snowtracking techniques. We sampled physiographic conditions, forest structure, and relative prey abundance in 5-m radius plots spaced 200-m apart along lynx trails (use), and along systematically arrayed 2-km transects (availability). We sampled 43 km of lynx trails and 30 transects during winter 2000-01, and 61 km of lynx trails and 48 transects during winter 2001-02. We also identified the contents of 46 scats collected along lynx trails (20 in year 1 and 26 in year 2). We used stepwise logistic regression to investigate fine-scale habitat selection by lynx. Because snow conditions varied substantially between years, we analyzed data for each year separately. Habitat selection by lynx was strongly influenced by snow conditions. In year 1, when temperatures stayed below freezing all winter and snow was powdery and dry, lynx were highly selective of firm snow, dense understory cover, and high snowshoe hare (*Lepus americanus*) abundances. In year 2, when frequent thaws and subsequent freezing temperatures resulted in multiple ice crusts in the snow profile, lynx did not exhibit selection for snow firmness or hare abundance; rather, they selected for flatter slopes and against mature forest stands and high red squirrel (*Tamiasciurus hudsonicus*) abundances. Our results suggest that when snow is powdery and dry, lynx have difficulty finding and/or killing snowshoe hares. In contrast, when snow is compacted, lynx are able to conserve energy by hunting on flatter slopes in a variety of habitat conditions that contain hares. Food habits data, which show that lynx relied more heavily on red squirrels in year 1 than in year 2, support these hypotheses.

[1]USDA Forest Service, Pacific Northwest Research Station, 3625 93rd Ave. SW, Olympia, WA 98512, kaubry@fs.fed.us

[2]USDA Forest Service, Rogue River National Forest, 47201 Highway 62, Prospect, OR 97536

[3]Washington Department of Fish & Wildlife, 600 Capitol Way North, Olympia, WA 98501

# 4. Development of a Cooperative Research Project to Study Canada Lynx in the Western Great Lakes Region

EDWARD L. LINDQUIST[1], RON A. MOEN[2], CHRISTOPHER L. BURDETT[2], GERALD J. NIEMI[2] AND STEVEN LOCH[1]

The Canada lynx (*Lynx canadensis*) was listed in 2000 as a threatened species under the U.S. Endangered Species Act. Listing created a legal obligation to increase understanding of the ecology and natural history of the species throughout its conterminous U.S. range. Initial survey efforts to determine the presence of Canada lynx in National Forests of the western Great Lakes region did not detect Canada lynx, but observations, photographs, and genetic analysis of hair and scat samples support the presence of Canada lynx in Minnesota for several years. A partnership including the USDA Forest Service, USDOI Fish and Wildlife Service, USGS Biological Resources Division, and the Minnesota Cooperative Fish and Wildlife Unit instituted the Minnesota Lynx Project coordinated out of the Natural Resources Research Institute. Defenders of Wildlife also contributed to this project. We have used a website (www.nrri.umn.edu/lynx) and internet technology to increase public involvement in the project. Project goals are to determine distribution, abundance, long-term persistence, and habitat use and requirements of Canada lynx. In the first field season 15 Canada lynx have been live-trapped and fitted with radiotelemetry collars. Of the 15 study animals we have documented 2 deaths. Several of the Canada lynx were fitted with GPS radiotelemetry collars. Downloaded data from some of these collars has provided detailed information on habitat use and behavior. GPS radiotelemetry locations, and standard VHF telemetry locations on a wider scale, will provide region-specific habitat data to guide decision-making on issues regarding Canada lynx conservation in the western Great Lakes region.

[1]USDA Forest Service, 8901 Grand Avenue Place, Duluth, MN 55808-1102, elindquist@fs.fed.us

[2]Natural Resources Research Institute, Center for Water and Environment, 5013 Miller Trunk Highway, Duluth, MN 55811

# 5. Utility of Forest Carnivores (American Marten and Canada Lynx) As Umbrella Species for Biodiversity Conservation

JEFFREY A. HEPINSTALL[1] AND DANIEL J. HARRISON[2]

Private forest landowners are expected to manage their commercial landscapes to maintain viable wildlife populations. Umbrella species have been proposed as a tool for simplifying biodiversity conservation by focusing on a few species with habitat needs that represent the minimal requirements for a diverse array of other species. Forest carnivores are often chosen as umbrella species because they are habitat specialists, are area sensitive, and are relatively uncommon. However, the effectiveness of umbrella species at protecting the habitat of other species has not been well documented. Our study uses two spatially explicit models developed for predicting habitat quantity, quality, and distribution in Maine for a mid-late successional species (American marten, *Martes americana*) and for an early successional species (Canada lynx, *Lynx canadensis*). Our study has three primary objectives: 1) evaluate how well regional models for martens and lynx accommodate the habitat needs of terrestrial vertebrate species that occur on commercial forestlands in northern Maine; 2) quantify the costs in vertebrate diversity of managing for either mid-late or early successional umbrella species; and 3) determine which vertebrate species "fall through the cracks" and require additional conservation initiatives. Preliminary results indicate that martens are an effective umbrella species for 81-84% of forest-dependent generalists and for 70-74% of forest-dependent specialists. Many of the species that are not benefited by conservation planning for martens require a combination of early and late successional forest, or are early successional forest obligates. Our ongoing analyses are evaluating whether these species would be benefited by complementary conservation of lynx habitat.

[1]University of Washington, Box 352100, Seattle, WA 98195-2100, jahwash@u.washington.edu

[2]University of Maine, 5755 Nutting Hall, Orono, ME 04469

# 6. Food Habits of the Red Fox, Marten and Coyote in the Lassen Peak Region of Northern California

JOHN D. PERRINE[1] AND REGINALD H. BARRETT[1]

Red foxes (*Vulpes vulpes*) in the mountains of North America are rare and their ecology has been virtually unstudied. We examined food habits of red foxes in the Lassen Peak region of northern California as part of a comprehensive ecological study of this State Threatened species. We also assessed dietary overlap with marten (*Martes americana*) and coyote (*Canis latrans)*, two common sympatric carnivores that may be red fox competitors. We collected scats from 1998 through 2002 at elevations from 1500 to 3200 m. The diets of all three species were composed primarily of mammals year-round, although winter sample sizes for marten and coyote were low. For red fox, pocket gopher and other rodents were important year-round, along with mule deer carrion. Marten diets were similar, with mice being the predominant rodent. Coyote diets were dominated by mule deer, with mice, squirrels and pocket gopher taken seasonally. Insects in summer and manzanita berries in autumn were common foods for all three species. Lagomorphs were virtually absent from all three species' diet, suggesting that population numbers in the area may be low. Dietary breadth was widest in spring and narrowest in autumn for all three species. Marten had the smallest seasonal change in dietary breadth (max/min = 1.14), while coyotes had the largest (max/min = 2.95). Dietary overlap among carnivore pairs ranged from 54% to 71%, and was largely attributable to seasonally abundant foods used by all three species. The heavy winter snows and lack of lagomorphs at high elevations may have important effects upon red foxes in this region.

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# LUNCHTIME MONDAY

## "Eye of the Whale"

DICK RUSSELL[1]

First published by Simon & Schuster, *Eye of the Whale* was named a "Best Book of 2001" by three major newspapers. To be issued in trade paperback in October by Island Press/Shearwater Books, it follows the migration of the California gray whale from its birthing place along Mexico's Baja peninsula to its feeding area in the Arctic's Bering Strait. Reviewer Richard Ellis described this book as one that "will change the way you think about the natural world."

In an hour-long slide presentation, author Dick Russell begins with remarkable photographs depicting the gray whale's friendly overtures toward human beings over the past generation, a phenomenon that has sparked the growth of today's whale watching industry. He describes the five-year-long fight of environmental groups that resulted in successful preservation of the gray's last pristine breeding habitat at Laguna San Ignacio. Along the migration, viewers will visit the Makah Indian reservation in northwest Washington, where renewed hunting of these whales after a 70-year hiatus sparked a nationwide controversy. By contrast, Russell takes us to native villages in Alaska and, particularly, along Russia's Chukotka Peninsula, where limited whale hunting remains essential to the people's survival. Interwoven is the remarkable story of Charles Melville Scammon, a 19th-century whaling captain who was responsible for bringing gray whales to the brink of extinction, but then had a change of heart and became a renowned naturalist.

Russell's presentation also examines an ongoing effort by Japan to bring about renewal of commercial whale hunting, as well as other contemporary threats to whale populations including climate change and Navy sonar.

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# MOUNTAIN LION CONSERVATION II

*Moderator: Lynn Michelle Cullens*

## 1. Prey Selection and Kill Rates of Cougars in Northeastern Washington

HILARY S. CRUICKSHANK[1], ROBERT WEILGUS[1], HUGH ROBINSON[1] AND CATHERINE LAMBERT[1]

We investigated prey selection of cougars (*Puma concolor)*in northeastern Washington during 2002-2004, where sympatric white-tailed deer and mule deer are the primary prey available. We tested two competing hypotheses of prey selection, the "prey switching" hypothesis, and the "apparent competition" hypothesis. White-tailed deer comprised the greatest proportion of cougar kills (60% vs. 40% for mule deer) and prey availability (70% vs. 30%) across the study area. Cougars selected for mule deer across the entire study area and showed strong seasonal changes in prey selection, with cougars strongly selecting for mule deer in summer, but not during winter. The mean annual kill rate of cougars was 6.68 days per deer kill. Kill rates did not differ between white-tailed deer and mule deer kills. These findings are consistent with the apparent competition hypothesis, suggesting that the mule deer decline in northeastern Washington is ultimately caused by an abundance of invading primary prey (white-tailed deer), and related increased predation on the secondary prey (mule deer) during summer.

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# 2. Public Opinions And Actions Relating To Mountain Lions In Southern California: Implications For Management Agencies

T. WINSTON VICKERS[1], WALTER M. BOYCE[2], MICHAEL H. ZICCARDI[2] AND CARRIE MCNEIL[2]

In California, mountain lion (*Puma concolor*) interactions with humans may have increased in recent years. Management agency response can be affected by citizens' opinions expressed through the political process, interest groups, and public comment. These opinions can influence decisions that directly impact lion populations via policies on public safety, depredation permits, endangered species, and land conservation, among others. This mail survey was designed to determine public opinion about issues that affect mountain lion conservation. We administered the survey in 2003 as part of the Wildlife Health Center's Southern California Program at U.C. Davis. Of 698 returned surveys, approximately 55% came from rural residents of San Diego County, and 45% came from residents of the city of San Diego and surrounding suburbs. Opinions of conservation in general, desirable numbers of mountain lions and other species, mountain lion policies, proximity of residence to lion habitat, and risk were determined. Other information from the survey included types of past interactions with mountain lions, animals owned, and protective measures in place or considered as reasonable in the future. Results suggest that the continued presence of mountain lions in Southern California is supported by the majority of urban and rural residents, including rural livestock and pet owners. Overall, risk posed by mountain lions was perceived as low. Univariate and multivariate statistical analysis showed that differences exist between urban and rural groups, as well as between subgroups such as livestock owners and those not owning livestock.

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# 3. Project CAT (Cougars and Teaching)

CONNIE ANDERSON[1], KATHERINE MALCOLM[1] AND BOYD KEYSER[1]

Project CAT (Cougars and Teaching) is an unprecedented collaboration between the Washington Department of Fish and Wildlife (WDFW) and the Cle Elum/Roslyn School District, utilizing a proactive educational program that promotes living with cougars (*Puma concolor*) through experiential curriculum, scientific exploration, and the application of advanced technologies. K-12th grade student volunteers, aided by their teachers and project biologists, participate in a wide variety of activities inside and outside of the classroom as they investigate the ecology and behavior of cougars and cougar prey during a period of rapid land development that is beginning to occur in the greater Cle Elum/Roslyn community. Within a global framework of integrated inquiry-based learning, Project CAT is designed to constantly provoke new questions that allow students to explore and eventually master the same rigorous scientific process demanded of the professionals that partner with them. Student participation in the capture, data collection, analysis, post-mortem retrieval, necropsy, and reconstruction of a local adult male cougar, "Tyron," highlights the experiences and education of high school and middle school students in Project CAT. These efforts combined with additional activities of middle and elementary school students to characterize the distribution of wildlife in the winter and cougar/prey habitat attributes in the spring, present a detailed picture of the dynamic role students play in this ground breaking project. "Through the eyes of a cougar, how is the Cle Elum-Roslyn area changing?" The students of Project CAT are a part of finding the answers, as this small rural community in the foothills of the Cascade Mountains is depending on their work to define solutions for future generations.

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# 4. The Mountain Lion and the City Lion: Approaching Coexistence In Changing Landscapes

LYNN MICHELLE CULLENS[1]

After four years of focused grassroots work to prevent the killing of mountain lions (*Puma concolor*) in retaliation for pet and livestock depredation in California, the Mountain Lion Foundation's "Living with Lions" program has developed a comprehensive method for mountain lion conservation in that state. There are distinct rural and urban mythologies about the mountain lion, and these beliefs are clearly reflected in human behavior. Acknowledging these demographic differences is key to providing a safe haven for lions in remaining wildlands. Creating "unlikely" partnerships with local and regional organizationsówith purposes as varied as mountain biking, goat husbandry, and water qualityóprovides the infrastructure (and the human interest) for changing people's perceptions about, and behavior toward, California's last great predator. We've learned to capitalize on the media's tendency to polarize carnivore issues. By working closely with those who might be expected to present opposition to conservation efforts, we create compelling human interest stories, and send a message of hope. Case studies of several local lion conservation projects highlight the collaborative nature of the program, and describe the challenge of adapting conservation goals to rapidly changing rural and urban landscapes.

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# MARINE SPECIES

*Moderator: Jim Curland*

## 1. Using Marine Mammals and Other Apex Predators to Monitor Ecosystem Change

ANDREW W. TRITES[1] AND DAVID A. S. ROSEN[1]

Apex predators are commonly thought to be good indicators of the health of ecosystems because they respond to changes in the quantity and quality of the prey they consume. Prey abundance directly affects individual behaviors (e.g., foraging times) and physiologies (e.g., metabolism and stress hormones), and can stunt or enhance body growth. At a population level, food affects birth and death rates, which can cause overall numbers to increase or decrease. Such individual and population level variables are meaningful indicators that something has changed in the ecosystem—but they are not easily interpreted.

Intensive studies of marine mammals over the past decade indicate that a wide range of inter-related data need to be collected to effectively use apex predators as indicators of ecosystem status, particularly to untangle the effects of changes in the quantity and quality of available prey (e.g., population size, diet, body condition, body growth rates, stress hormone concentrations, abortions, birth rates, survival rates and foraging trip lengths). Using marine mammals as effective indicators of ecosystem change requires a commitment to long-term monitoring. The most valuable combination of parameters to measure appears to be population size, diet and individual body condition—particularly for young animals. As K-selected species, adult marine mammals tend to buffer the effects of decreases in quantity and quality of prey better than young animals, and are therefore less sensitive indicators of ecosystem change. Young animals, however, appear to be extremely sensitive barometers of changes in prey and are potentially a useful age group to monitor ecosystem status.

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# 2. Assessing the Short-term Effects of Human Disturbance on Steller Sea Lion Behavior*

LAURA KUCEY[1] AND ANDREW W. TRITES[1]

As marine mammal conservation research increases worldwide, one of the major questions facing scientists and permit-issuing authorities is whether or not disturbances from researchers are adversely affecting the populations under investigation. Knowledge of how populations and individuals respond to disturbance is vital in determining population viability in the face of increasing human pressure from commercial fisheries and tourism operations. Steller sea lions (*Eumetopias jubatus*) are an endangered species in the Aleutian Islands and Gulf of Alaska and are currently under intensive study. Steller sea lions typically haulout of the water at preferred sites in large groups to rest in between foraging trips. However, major disturbances occur when researchers go onshore to collect scats (fecal samples) or to capture animals. This usually results in animals entering the water and leaving the haulout site for a period of time. Our study investigated the effects of such directed disturbance, as well as other potential anthropogenic factors. Counts and behavioral observations were conducted on six Steller sea lion terrestrial resting sites in British Columbia and Southeast Alaska (areas of stable populations), before and after scat collection in May-August 2003 and February-April 2004. Response of sea lions varied considerably between locations and seasons. Summer results showed that the mean number of animals on land at our study sites decreased after the directed disturbance. Results from this study provide insight into the potential effects of human disturbance on sea lion behavior that may guide research activities, air and boat operations, and human approaches in areas of sea lion habitat.

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# 3. Zonal Management of Southern Sea Otters: An Ideal Compromise or Flirting with Disaster?

GREGORY S. SANDERS[1]

In 1987, the U.S. Fish and Wildlife Service initiated a plan to translocate southern sea otters (*Enhydra lutris nereis*) from central California to historical habitat in southern California. In concert with this plan, an unprecedented management strategy for the southern sea otter population was implemented. Sea otters entering a designated management zone were removed, using non-lethal means, and released into areas deemed appropriate for sea otter occupation. Such a "zonal management" approach may appear to be an ideal compromise between the species' needs and competing human interests; however, for the southern sea otter, zonal management could ultimately jeopardize the species' continued existence. Our experience with the southern sea otter translocation program has demonstrated that zonal management of sea otters is an elusive goal. Non-compliant sea otters transgressed the defined, yet invisible, border of the management zone at will. Otters captured and moved hundreds of miles returned to the management zone or died shortly after their release into unfamiliar waters. Enforcement of the management zone would result in a continuous disruption of natural range expansion, with potentially disastrous consequences for the social structure of the population. We are currently reevaluating the translocation program and its mandate for zonal management. The results of this evaluation should be considered when contemplating zonal management for other wildlife populations.

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# 4. The Sea Otter in North America: Defenders of Wildlife's Efforts in Conservation, Advocacy and Education

JIM CURLAND[1]

Defenders of Wildlife's marine program focuses on specific issues that will have the greatest overall impact to our coastal and marine environment. Working in collaboration with conservation organizations and scientists, Defenders focuses on marine protected areas, fishing conflicts, recovering marine species, particularly the threatened southern sea otter, and reducing pollutants in our coastal waters. A thriving marine environment will engender economically viable and healthy coastal communities. Sea otters are one of the most critically imperiled marine mammals and classic keystone species. Sea otters prey on kelp-eating marine herbivores, allowing kelp and other macro-algae to flourish and provide habitat for numerous fish species. When sea otters are absent, these rich ecosystems collapse. Additionally, sea otters serve as sentinel species of the coastal near-shore ecosystem. If otters are unable to thrive or are declining, their plight may indicate significant problems with the overall health of the coastal ecosystem — which may also affect human health. Unfortunately, the sea otter continues to face a number of threats, including harassment and entanglement in fishing gear and habitat degradation, which includes oil spills and the impacts from other environmental contaminants. Defenders' primary focus is on the southern and Alaskan sea otter populations, while we are involved with issues related to the Washington state and Canadian sea otter populations. The southern sea otter campaign includes educational outreach, stakeholder meetings, advocating strong recovery planning and implementation, minimizing fishery conflicts, and securing federal and state research money. The Alaskan sea otter campaign focuses on public education, outreach and advocacy.

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# MESOCARNIVORES II

*Moderator: Michael Schwartz*

## 1. The Relative Importance of Habitat Variables and Species Co-Occurrence for Predicting Mesocarnivore Species Presence

SARAH REED[1] AND ELAINE F. LESLIE[2]

Developing regression and classification models of carnivore species occurrence using geographic information system (GIS) technologies are increasingly popular techniques for predicting species distributions, habitat suitability and population viability. In general, models are developed for individual species based on dependent site and landscape variables related to habitat quality. However, recent research shows that the distribution of an individual species can be an important determinant of the composition of the rest of the carnivore community, and excluding co-occurring species from models could result in misestimation of population size, density or probability of occurrence. The objective of our research is to quantify the relative importance of habitat variables and species co-occurrence for predicting carnivore species presence. We conducted our research in Grand Canyon National Park, in ponderosa pine and pinyon-juniper forest ecosystems that support at least ten extant species of native carnivores. We randomly selected 58 sites to sample carnivore species presence throughout the study area in 2003 and 2004. Sites were sampled using a suite of passive wildlife monitoring techniques in order to maximize the likelihood of detecting all target species. In addition, we collected and derived common habitat variables for all monitoring sites. We used logistic regression and classification tree analyses to test the relative importance of habitat variables and species co-occurrence for predicting the presence of each carnivore, comparing model predictions with and without the inclusion of co-occurring species as dependent variables. Our results indicate that incorporating co-occurrence rates among carnivore species may improve predictive models for areas where exhaustive sampling is not possible.

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# 2. Evaluating the Impact of Translocations on Montana Fisher Populations

RAY S. VINKEY[1], MICHAEL K. SCHWARTZ[2], KERRY R. FORESMAN[3], KEVIN MCKELVEY[2], BRIAN J. GIDDINGS[4] AND KRISTY PILGRIM[2]

Translocations play an important role in the conservation and restoration of wildlife populations. We investigated the impact of translocations on the distribution and genetic structure of fisher (*Martes pennanti*) populations in Montana. To approximate the occupied range of fisher throughout the state, we mapped fisher distribution using contemporary occurrence data (harvest, sighting, and tracking records). The spatial and temporal extent of these records demonstrates that translocations have been successful in establishing fisher populations in Montana. To investigate the origin of extant populations, tissue samples from Montana, British Columbia, Minnesota, and Wisconsin fishers were collected and two regions of the mitochondrial DNA genome (the control region and cytochrome b) were examined. Haplotype frequencies differed significantly by region. Reference populations had seven non-overlapping haplotypes: four unique to British Columbia, two to the Midwest, and one to west-central Montana. The distribution of these haplotypes in Montana suggests that fisher populations in the state have multiple origins reflecting the history of translocations and the influence of native populations. Our analysis of mitochondrial DNA sequence data, documents for the first time that native fisher may not have been extirpated from Montana. West-central Montana fisher populations show evidence of isolation and distinctiveness, suggesting that they are descended at least in part from remnant native populations.

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# 3. The Decline of the Eastern Spotted Skunk and Results of Recent Survey Efforts in Missouri

H. MUNDY HACKETT[1] AND MATTHEW E. GOMPPER[1]

Since the 1940s, the eastern spotted skunk (*Spilogale putorius*) has become increasingly rare throughout the United States. This once economically important furbearer, with consistent annual harvests of 100-200,000 animals, is now threatened, endangered, or of special concern throughout its historic range. We examined long-term harvest records from 12 states to better understand the modern history of the species, to discern whether the perceived decline was biologically real or an artifact of altered harvest pressures, and to identify the timing of the decline. In the early part of the 20th century, harvest records reveal unequivocally that the species was common in the Great Plains. About 1940, harvest levels in these states declined precipitously, and though these declines commenced at different times in each state, there is no question of its existence. By the early 1950s total harvests were <10% of pre-crash numbers. Since that time, rates of decline have slowed but have not reversed themselves, and by the 1980's harvests were <1% of those during pre-decline years. Our analyses show that these declines are real, not an artifact of harvest effort or pelt prices. The causes of these declines remain unclear, and clearly suggest a need for immediate attention to address the long-term persistence of this species. To this extent, in 2003 we began systematic statewide surveys in Missouri to attempt to identify existing populations of the eastern spotted skunk and develop predictive models aimed at identifying areas where the species is likely to persist.

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# 4. Using Ontogenetic Data to Test Phylogenetic Environmental Hypotheses of Bulla Size in Carnivores

ALANA K. KAWAKAMI[1]

The auditory bulla is an important source of environmental information for an organism. Changes in its structure may affect the range of frequencies that an organism is sensitive to. Previous studies of rodents have shown that a larger bulla is more effective in enabling an individual to hear low frequency sounds, and, therefore, avoid predation. Other studies of carnivores have suggested that an enlarged bulla may have been a response to the need to hear low frequency sounds in an open environment. Therefore, a correlation should exist between an open habitat and an enlarged bulla.

Heterochronic events in development play a significant role in evolutionary biology. Here I present results of a study examining the effects of heterochrony on skull growth in various species of the Herpestidae (mongoose) family. I used several measurements, including an estimate of bullar volume, and a head-body length measure, if one was available for the individual specimen. Relative age of juveniles was determined using tooth eruption sequence and suture closures. Results indicate that changes in the relative timing and rate of growth are responsible for some variation in bulla size relative to body size. Although relative bulla size may vary, absolute size may be similar in species of varying sizes and habitats. Other factors, such as the morphology and physiology of the inner ear, may be responsible for the full range of frequencies to which an organism is sensitive. This suggests that bulla size may be more of a reflection of phylogenetic history rather than environmental pressures.

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# COUGARS, CORES AND CORRIDORS

*Moderator: Lynn Sadler*

## 1. Influence of Vegetation, Roads and Topography on Puma Movement

BRETT G. DICKSON[1] AND PAUL BEIER[2]

Models of puma movement can help conserve pumas in human-altered landscapes, but cannot be constructed solely by analyzing daytime resting locations. We examined the movements of 10 female and 7 male pumas (*Puma concolor*) at 15-min intervals during 44 nocturnal or diel periods of hunting or traveling in the Santa Ana Mountain Range of southern California. Pumas tended to move in a meandering path (mean turning angle ~54 degrees); distance moved per 15 minutes (mean and mode ~300 m) was not correlated with turning angle. During movements, puma preferences for vegetation-land use types (riparian > scrub > chaparral > grassland > woodland > disturbed) were similar to their preference for daybed locations (riparian > scrub > woodland > chaparral > grassland > disturbed). However, the statistical strength of these differences was less pronounced, suggesting that pumas use a broader range of habitats for nocturnal movement than for daytime rest sites. Pumas traveled slowest through preferred habitats and fastest through low-ranked habitats. Traveling individuals showed preferences among 4 classes of topographic features (canyon bottoms > gentle slopes > steep slopes > ridgelines) and avoided two-lane paved roads, but dirt roads may have facilitated movement. Our results suggest that corridors designed for puma should include riparian vegetation and other vegetation types that provide horizontal cover, should tend to follow canyon bottoms and gentle topography, and would not be harmed by dirt roads in the corridor. Pumas did not use highway-crossing structures to trap prey.

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# 2. Cougar-Human Interactions: Movement Patterns and Behavior Along the Urban-Wildland Interface*

DAVID C. STONER[1] AND MICHAEL L. WOLFE[1]

Potential conflicts between cougars (Puma concolor) and humans arise from the spatial overlap and complex interaction of behaviors on the part of both species. The primary long-term human impact on cougars is habitat modification. Conversely, cougar impacts on humans stem principally from foraging and dispersal behaviors near urban areas. In the western United States, urbanization adjacent to public lands has occasioned the juxtaposition of human communities and wildlife habitat. In addition to seasonal elevational migrations, irrigation and associated landscaping around homes may bring ungulates into foothill regions, thereby attracting cougars to areas of human activity. These interactions may be further complicated by hunting systems that modify the sex and age composition of the cougar population to one with a higher proportion of potential nuisance animals. We have been monitoring a cougar population in the Oquirrh Mountains of north-central Utah since 1997. The population is subject to minimal hunting kill and resides on the periphery of the greater Salt Lake metro area. The area is characterized by rapid suburban expansion, which will continue during coming decades. Residential development in the area comprises two variants: (1) low-density ranchettes; and (2) conversion of former agricultural lands into high-density planned communities. Here we examine the implications of these scenarios in light of cougar movement patterns, feeding behavior, and habitat use determined from GPS telemetry. We argue that the two development models pose differential risks for negative interactions between humans and cougars. Alternatives for managing cougars on the urban-wildland interface are also discussed.

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# 3. An Individual-Based Movement Approach to Evaluating Connectivity for Mountain Lions in Southern California

JEFF A. TRACEY[1] AND KEVIN CROOKS[2]

Landscape change due to urban, agricultural, and transportation infrastructure development can alter the ability of animals to move among remaining core habitat areas. Coastal southern California has been severely fragmented by such development, jeopardizing the persistence of mountain lions (*Puma concolor*) in the region. We use statistical models of individual animal movement and individual-based movement models (IBMMs) to predict movement on geographic information system landscape models of conservation interest. We briefly introduce these models, and then describe IBMM output specific to simulated locations and paths that are useful in evaluating connectivity. We provide methods that use this output to visualize connectivity, to quantify connectivity among pairs of core habitat areas, and to quantify resistance that specific landscape elements provide to movement. We apply this approach to the evaluation of connectivity for mountain lions in southern California. The IBMM simulations identify key linkages among core habitats, along with predicted probability of success, cost of use, and risk of use for large carnivores. These results are being used to guide the design of habitat conservation plans (HCPs) in our study area. As such, this approach has the potential to become a useful tool in reserve design and proactive conservation measures.

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# 4. Designing Linkages for Pumas (and Other Species) — A Sensitivity Analysis of GIS Models*

SHAWN NEWELL[1] AND PAUL BEIER[2]

Least Cost Corridor Analysis (LCCA) is a popular GIS-based tool in planning wildland networks. For instance, the South Coast Missing Linkages project used this tool to design linkages between 15 major pairs of wildlands in southern California. We used sensitivity analysis to determine how each species' LCC map, and the union of those maps, varied with (a) weights given to each of 4 *factors* (vegetation/land use, road density, topographic position, elevation), (b) scores given to each *class* within a factor (e.g., each vegetation class, road density class, etc.), (c) choice of an additive model (potentially allowing compensation among factors) versus a multiplicative model (the worst factor becomes a limiting factor), and (d) number of focal species.

As we changed scores for varioys classes within factors, maps for individual species changed modestly. Mean overlap of the rescored maps with maps made using experts' best guess scores was 91 percent. We wil present additional results on the effects of factor weights and increasing the number of focal species.

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# 5. Movements, Activity and Food Habits of Mountain Lions in A Fragmented Urban Landscape in Southern California

SETH P.D. RILEY[1], ERIC C. YORK[1], JEFFREY A. SIKICH[1], CASSITY BROMLEY[1], CATHERINE M. SCHOONMAKER[1] AND RAYMOND SAUVAJOT[1]

Urbanization presents significant challenges for the conservation of carnivores in general and of large carnivores in particular. Large carnivores have the largest spatial requirements and can also come into direct conflict with humans and domestic animals. Since 2002, we have been studying the behavior and ecology of mountain lions (*Puma concolor*) in a highly fragmented landscape in urban southern California. Although lion home range sizes are similar to those found in other parts of the southwest, abundance appears to be low in this area, as available habitat is limited. Food does not appear to be a limiting factor and lions are making 2-4 deer kills per month. Movement across barriers, specifically freeways, is essential for the long-term survival of lion populations in this area. No lion movement has been detected across the 101 freeway, a busy 8-10 lane road.

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# 6. Panel Discussion: Managing for Connectivity

PAUL BEIER[1], JEFF TRACEY[2], LINDA SWEANOR[3] AND RICK HOPKINS[4]

Land trusts, conservation groups and government agencies are increasingly providing funding and incentives to protect and restore wildlife linkages. The challenge now is to manage those corridors so that they continue to provide permeability. Lack of monitoring, inadequate buffering, inappropriate "compatible recreational uses," and human activity all threaten to render many linkages useless at best and death traps at worst. This panel discussion will explore obstacles to permeability, possible solutions to barriers and research suggestions that would inform corridor protection efforts.

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# ENVIRONMENTAL EDUCATION ON CARNIVORES

*Moderator: Patrick Valentino*

## 1. Carnivore Education: Beyond Biology

ANDREA L. STRAUSS[1]

Carnivore education has traditionally focused on biology and management. This approach has helped to correct misunderstanding of carnivores, and in particular wolves (*Canis lupus*), but does not address the underlying human value conflicts that are responsible for much of the controversy surrounding these animals. Many people may like or dislike wolves, for example, independent of correct biological understanding of them. Carnivore education must evolve to include more than just biological topics, it must also include consideration of the human dimensions of carnivores, including the role of culture, ethics, economic valuation, and moral values in the development of each person's thinking about them. Because the underlying disagreements about carnivores tend to center around these issues, education that helps people to analyze the origins and implications of human attitudes towards carnivores generates a public debate with more rationality and integrity. Using wolves and the International Wolf Center's educational programs and services as a case study, this presentation will discuss some new approaches to carnivore education and outline some challenges for the future.

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# 2. Wolves in Education Programs: Wolf Park's 32 Years of Public Education

HOLLY JAYCOX[1]

Educating the world about the realities of wolves is a vital part of wolf conservation. There are many debates about the best way to carry out this education. In Battle Ground, Indiana, people have been visiting Wolf Park for 32 years, to learn more about wolves. One thing that sets Wolf Park apart from other wolf facilities is that its programs that allow people to actually meet a wolf in person, under prescribed circumstances. This talk will address the ins and outs of doing wolf education in a setting that includes no wild wolves, a group of captive wolves, and has programs ranging from a one-hour tour to a three-month internship. We believe that a combination of a personal, up close interaction with a wolf, combined with factual information about the species, can make a large impact.

[1]Wolf Park, 4004 E. 800 N., Battle Ground, IN 47920, wolf_magazine@wolfpark.org

# 3. Tricks of the Trade: Teaching About Wolves During Re- and De-Classifications

PAM TROXELL[1]

The federal government reclassified wolves (*Canis lupus*) in Wisconsin and Michigan in 2003 to a threatened status. Wisconsin reclassified wolves to a threatened status in 1999 and Michigan reclassified in 2002. Currently, Wisconsin is in the process of delisting the wolf at the state level; Michigan will soon follow suit. It is a time of transition when success butts up against confusion and misunderstanding. Education no longer draws the line between protection of the wolf vs. no protection. Dispelling myths by teaching exclusively about wolf ecology like we as educators did a decade ago, is now replaced with a more complicated myriad of educational themes where the clear line grows fuzzy. The themes include wolf behavior, wolf identification, human behavior around wolves, response to depredations and wolf ecology. Timber Wolf Alliance, a non-profit, education program based in Wisconsin and Michigan, uses its strong volunteer speakers' bureau network to develop innovative and traditional techniques to get at this education puzzle. This presentation will briefly review some of the education tools and activities that volunteers have and are using to deflate rumors and dispel fears.

[1]Timber Wolf Alliance, Sigurd Olson Environmental Institute, Northland College, 1411 Ellis Ave, Ashland, WI 54806, ptroxell@northland.edu

# 4. On the Edge: Neighborhood Wildlife Education in Urban Southern California

MOLLIE HOGAN[1], BETH CASKIE[2], STEPHEN HARRIS[3], CHRISTA MANN[4] AND LYNN MICHELLE CULLINS[5]

On The Edge is an exciting and successful partnership among existing organizations and agencies that is designed to: (1) Reduce human-wildlife conflicts on the edge of conserved lands in Los Angeles and Ventura Counties; (2) Increase public understanding of the value of wildlife and wildlife habitat; (3) Encourage changes in personal lifestyles that reflect this understanding; and (4) Develop a collaborative regional model for inter-organizational wildlife education programs. Five original partner non-profits all hoped to create a strong wildlife education program for adults, focused to resolve conflicts and promote conservation on the urban edge. But no single group could afford to provide a comprehensive program. Nature of Wild Works (a wildlife education group), Mountains Restoration Trust (a regional land trust), California Wildlife Center (a wildlife rescue and rehabilitation facility), and the Mountain Lion Foundation (a national carnivore conservation group) created a successful partnership, attracting additional agency partners at the Federal, State, and local level. We will present an example of program content, describe the model we use to collaborate, and discuss how message development is affected by a multi-organization partnership.

[1]The Nature of Wildworks, P.O. Box 109, Topanga, CA 90290, wildworks1@aol.com

[2]California Wildlife Center, P.O. Box 2022, Malibu, CA 90265

[3]Mountains Restoration Trust, 3815 Old Topanga Canyon Rd, Calabasas, CA 91302

[4]On the Edge, 15750 E Los Angeles Ave #59, Moorpark, CA 93021

[5]Mountain Lion Foundation, P.O. Box 1896, Sacramento, CA 95812

# 5. Communicating About Carnivores: Education is Key on the Urban-Wildland Frontier

PENELOPE GRENOBLE O'MALLEY[1]

A fundamental challenge to carnivore research in areas where urban development causes fragmentation and loss of habitat is that if current conditions remain unchanged populations are likely to be lost before adequate study can be accomplished. A valuable case in point is cougars (*Puma concolor*) in California. More and more animals are falling prey to human factors, including automobiles, depredation permits and removal as threats to public safety. From recent research in southern California, which has the longest continuous frontier between developed and wild land in the country (400 miles), have come repeated calls for more public education as the most effective way to save what lions are left in these rich and varied ecosystems. Yet to be determined is what form this education should take and under whose auspices it should be delivered. Public agencies are often suggested but these are notoriously slow and tradition-bound. Local NGOs, which are traditionally more limber and may more effectively get the word out, are chronically understaffed and underfunded. This presentation suggests that educating the public about coexisting with carnivores may be vital at the urban-wildland frontier and entertains suggestions about where, when and how such messages might be delivered.

[1]University Press of Colorado, 1649 Corsica Place, Costa Mesa, CA 92626, penelopeo@attglobal.net

# 6. Environmental Education Materials on Felids for Rural Areas in the Mexico-U.S. Border

PATRICIA MANZANO-FISCHER[1], RURIK LIST[1] AND ERIC LIST[2]

Felids, and particularly the large ones, often get in conflict with human interests, which results in the extermination of the problem animals, other individuals and even other species. In Mexico, there are laws that protect carnivores, but in the remote areas of the country there are no law-enforcement officials. Thus, predator control is conducted solely by the affected people, who often have misconceptions about carnivores that lead to their extermination. The recovery of neotropical felids in the U.S. depends on the conservation of their populations in Mexico, and this, in turn, largely depends on the ranchers of the remote areas where felids are still present. In an attempt to create a new understanding about carnivores in general and felids in particular in the rural regions of the Mexico-U.S. border, we developed a workbook and a teacher's guide on felids, with the idea that the best way to reach the community is through their kids, and the most efficient way to do this is to use the only source of information in these communities: the school. An important objective is to involve the families with the activities of the materials. The Teacher's Guide gives basic information to the teachers, whom frequently have no other source of information than the official text books. The workbook offers related activities for students to perform with the family and neighborhood, which helps to spread the information through the community. The education materials were requested and reviewed by the Bordercats Working Group.

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2Agrupación Dodo A.C., Atoyac 55, Col. Cuahutemoc, México, D.F. 6500, México

# 7. Engaging New Audiences and Educating Those Pesky Tourists

STEVE SHIMEK[1]

Sea otters (*Enhydra lutris*) are charismatic, enjoyable and easy to observe, and their diet of shellfish — consumed at the rate of 30 percent of body weight per day — is in direct conflict with certain shellfish fishermen. The Otter Project has undertaken and supported two education programs: one targeting children and designed to encourage their unique voices as advocates for sea otter recovery, and the second program designed to ease conflicts between otters and recreational kayakers. The Otter Project receives dozens of letters from children every year asking for help with reports or asking how they can help. However, The Otter Project is not an educational organization; the target audience has been voting adults and policy makers. This session will describe efforts to use the voices of children for advocacy. Goals of the program include: educating kids about the methods, tools, and "targets" of advocacy campaigns; the importance of their unique voice; and how to use their voice in age-appropriate ways, including art as well as the written word. Along the coast of Monterey County there is no question that kayakers are disturbing sea otters, a federal violation. Researchers are conducting multi-year studies of the problem, citizens were suggesting closure of kayak operations, and residents were calling authorities every time a kayaker came near an otter. The Otter Project joined with Monterey Bay National Marine Sanctuary to create the TeamOCEAN kayak-docent program. In its third year, TeamOCEAN staff and volunteers spend the summer, in kayaks, interpreting the marine environment and providing wildlife viewing education.

[1]The Otter Project, 3098 Stewart Court, Marina, CA 93933, exec@otterproject.org

# BADGERS

*Moderator: Kim Delfino*

## 1. Evolution of American Badger and the "Badger" Ecomorph

PAMELA R. OWEN[1]

To fully understand the adaptations of the American badger (*Taxidea taxus*) to its environment, one must address how behavior, ecology, and phylogeny shape its morphology. The label "badger" has historically been applied to several medium- to large-bodied mustelids that are generally characterized as fossorial omnivores. The evolutionary history of American badgers is particularly interesting, given recent study and description of new fossil taxa. Are the similarities among American and Eurasian badgers evidence of monophyly or ecomorphy? To answer this question I conducted a study of the morphology of American badger taxa. I utilized high-resolution X-ray computed tomography (HRXCT) for non-destructive visualization of the internal morphology of the crania of *Taxidea taxus* and a new fossil badger. Features such as hollowing of the mastoid region and a septate and greatly inflated entotympanic component of the bulla are made visible and provide evidence of phylogenetic relationship. To identify monophyletic groups and patterns of convergence I compiled a morphological data set that included craniodental, postcranial, and soft tissue characters for a phylogenetic analysis of the Mustelidae. Results from morphological and phylogenetic analyses support ecomorphy and the independent acquisition of "badger-like" dental and skeletal morphology. The fossil record suggests the "badger" ecomorph evolved at least twice in Mustelidae, with species diversification concurrent with global environmental change in the Late Miocene epoch. American badgers have been fossorial for at least seven million years and have increased in body size and dental complexity.

[1]Texas Memorial Museum, The University of Texas at Austin, 2400 Trinity St., Austin, TX 78705, powen@mail.utexas.edu

# 2. Ecology of a Badger Population on the Chaparral Wildlife Management Area in Southern Texas

DANIEL COLLINS[1], LOUIS A. HARVESON[2] AND DONALD C. RUTHVEN III[3]

Little information exists on American badgers (*Taxidea taxus*) in their southern distribution. I investigated the ecology of a badger population on the Chaparral Wildlife Management Area located in southern Texas from February to November 2002. My objectives were to gather baseline data on the ecology of badgers including population characteristics, home range, habitat use, movement patterns, microhabitat selection, and food habits. Trapping efforts resulted in the capture of 5 individuals (4 M, 1 F) with a mean weight of 6.1 ± 0.59 kg ($\bar{x}$ ± SE). Home ranges and mean daily movements for 3 male badgers averaged 7.0 ± 3.45 km≤ and 758 ± 800.7 m, respectively. Badgers did not use habitats in proportion to availability and showed a preference towards the mesquite (*Prosopis glandulosa*) savannah-thorn woodland. Badgers selected burrow sites dominated by a mesquite-bufflegrass (*Pennistum ciliare*) association. Badgers in southern Texas consume a variety of vegetative material and small mammals, suggesting they are more opportunistic than their northern counterparts. Although samples sizes were small, this study provides insight into the ecology of badgers in southern Texas.

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[2]Sul Ross State, Department of Natural Resource Management, Box C-16, Alpine, TX 79832

[3]Texas Parks and Wildlife Department, Matador Wildlife Management Area, 3036 FM 3256, Paducah, TX 79248

# 3. Ecological Factors Associated with the Distribution of Badgers in the San Francisco Bay Region*

CHRIS M. LAY[1]

Like many other mammalian carnivores, populations of American badgers (*Taxidea taxus*) may be prone to eventual extinction within fragmented landscapes due to their large home ranges, low densities, and negative interactions with humans. In California, badgers have declined or disappeared in regions of the state which have experienced dramatic growth in agriculture and sub/urban development over the last century. Current badger populations in the San Francisco Bay Area appear to be restricted to the relatively unfragmented mountainous areas that punctuate the region. I collected presence/absence data using sign surveys at 30 different sites in this region from November 2002 to March 2003. Using GIS technology, I also measured several large-scale variables, including road and highway densities and surrounding sub/urban and agricultural land use. At a smaller scale, I measured relative prey densities of gopher (*Thomomys bottae*) and ground squirrel (*Spermophilus beecheyi*) based on sign surveys at each site. My preliminary results indicate that the presence of badger sign is associated with low overall road densities and low amounts of surrounding sub/urban land use. This suggests that badgers may be avoiding suitable habitat that is adjacent to sub/urban areas. Thus, they may be restricted to the unfragmented centers of available habitat. I am in the process of developing a logistic regression model to predict badger occurrence throughout this region. In the future, this may allow land managers to evaluate the impact of future land-use changes on the populations of badgers in this region.

[1]San Jose State University, 741 N. Branciforte Ave, Santa Cruz, CA 95062, chris_lay@nols.edu

*student competition

# 4. Genetic Structure of Sensitive and Endangered Northwestern Badger Populations

CHRISTOPHER J. KYLE[1], RICHARD D. WEIR[2], NANCY J. NEWHOUSE[3], HELEN DAVIS[2] AND CURTIS STROBECK[1]

North American badgers (*Taxidea taxus)* are fossorial carnivores present in many arid regions of central and western North America. Negative demographic trends have prompted recent discussion regarding their conservation status, and resulted in sensitive and endangered designations for Alberta and British Columbia populations, respectively. However, metapopulation structure and factors affecting dispersal among regions are poorly understood for badgers. To provide a preliminary assessment of genetic structure and variation, badgers from Alberta, British Columbia, and northcentral and northwestern Montana were sampled, including individuals from two subspecific designations: *T. t. jeffersonii* and *T. t. taxus*. All individuals were genotyped at 12 microsatellite loci. Relative to other North American mustelids, high levels of genetic variation were observed in all regions (average HE = 77%), with the exception of the Thompson/Okanagan population (HE = 67%). Our results suggest that there is little restriction of gene between the two sampled *T. t. taxus* populations, and within mountain ranges for *T. t. jeffersonii* populations. In contrast, minimal gene flow was observed between populations separated by mountain ranges. Our results support the current geographic delineation of *Taxidea taxus* subpecies, and have implications for their conservation in the northwestern portion of their range.

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[2]Artemis Wildlife Consultants, 4515 Hullcar Road, Armstrong, BC V0E 1B4, Canada

[3]Sylvan Consulting Ltd., RR5, 3519 Toby Creek Road, Invermere, BC V0A 1K5, Canada

# 5. Life on A Highway: Sources of Mortality in an Endangered British Columbian Badger Population

RICHARD D. WEIR[1], HELEN DAVIS[1], CORINNA S. HOODICOFF[2] AND KARL W. LARSEN[3]

Populations of the British Columbia sub-species of North American badger (*Taxidea taxus jeffersonii*) are endangered, but relatively little is known about the factors that have contributed to this status. To assess the sources of mortality within this population, we radio-tagged and monitored 13 free-ranging badgers in the Thompson region between 1999 and 2002. During 4,791 radio days of monitoring, we documented the deaths of 6 radio-tagged animals. We also recorded the mortality of 1 of the radio-tagged badgers after monitoring had ended. Six of the 7 badgers were killed on roads or railways, in addition to at least 11 other untagged badgers that suffered the same fate. Most of these mortalities occurred during July when traffic volumes peaked and the movements of badgers were greatest. The survivorship of badgers in the Thompson region may be related to the frequency that animals crossed roads and the density of paved roads within their respective home ranges. Research is currently underway to assess the efficacy of alternative crossing structures and modified concrete roadside barriers to reduce badger road mortality.

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[2]University of Victoria, Department of Biology, Victoria, BC V8W 3N5, Canada

[3]University College of the Cariboo, Department of Natural Resource Science, 900 McGill Street, Kamloops, BC V2C 5N3, Canada

# 6. Translocation as a Promising Tool to Aid Recovery of Badger Populations

NANCY J. NEWHOUSE[1], TREVOR A. KINLEY[1], G. TIMOTHY MCALLISTER[1], RICHARD W. KLAFKI[1] AND ALAN D. DIBB[2]

The subspecies of American badger present in British Columbia (*Taxidea taxus jeffersonii*) is listed by COSEWIC as endangered and is on the provincial red list. Within the East Kootenay Trench, the badger population in the Kootenay River valley appears to be stable to possibly increasing slightly, but that of the upper Columbia River valley has approached extirpation. It is not clear whether trends in the upper Columbia were a product of a long-term loss in the area's ability to support badgers, suggesting recovery would be unlikely, or simply the result of random events in a low-density population, indicating recovery is possible under appropriate conditions. As a means of fast-tracking population recovery while testing the area's ability to support a recovering population, we translocated badgers into the upper Columbia valley. In the summers of 2002 and 2003, we radiotagged and translocated 15 badgers that were of the same subspecies and genetically similar to those in the East Kootenay from the Kalispell, Montana area. These included 7 adult males, 4 adult females, 2 juvenile males, and 2 juvenile females. As of December 2003, at least 3 of the 7 badgers released in 2002 were alive, 1 was dead of unknown causes, and 3 could no longer be radiolocated. One of the live animals was a female, and she weaned 1 kit in 2003. Of the 8 badgers released in 2003, 3 were known to be alive and 5 (4 juveniles) were at least temporarily lost from radiotelemetry contact. Early indications are that (1) survivorship among known-fate translocated adults is as at least as high as for East Kootenay resident badgers; (2) 7 of 11 adults and 0 of 4 juveniles remained in radiotelemetry contact; (3) all released adults known to be alive remained entirely or partially within the release area; and (4) kit production has occurred. Thus, preliminary indications are that the upper Columbia River valley remains capable of supporting a badger population, and translocation has so far been an effective means of enabling or speeding recovery.

[1]Sylvan Consulting Ltd., RR5, 3519 Toby Creek Road, Invermere, BC V0A 1K5, Canada, sylvan@rockies.net

[2]Parks Canada, Box 220, Radium Hot Springs, BC V0A 1M0, Canada

# 7. Assessment of Badger Damage to Machinery and Livestock

RICHARD D. WEIR[1], HELEN DAVIS[1], DON GAYTON[2] AND ERIC C. LOFROTH[3]

The jeffersonii subspecies of North American badger (*Taxidea taxus jeffersonii*) is an endangered species in the southern interior of British Columbia. Its habitat overlaps with many agricultural operations, particularly cattle ranches, horse farms and hay farms. Badger burrows are often cited as sources of damage to livestock and agricultural machinery. In an effort to document the actual frequency and extent of this damage, a telephone survey was conducted of 131 randomly selected cattle ranchers within the range of badgers in British Columbia. One-third of ranchers surveyed reported having badgers occur on their ranches within the previous five years. Of the ranchers who reported badgers, 66% felt they were either beneficial or had no effect on their agricultural operations; 21% felt they were detrimental and the rest (13%) had no opinion. Although damage to farm machinery by other burrowing animals was frequently reported, badger burrows were not conclusively linked to any of the damage occurrences. Injury to livestock as a result of animal burrows was less frequently reported than damage to machinery, of which one case was attributed to a badger burrow (1 of 131 respondents; <1%). A separate telephone survey was conducted of large animal and mixed practice veterinarians in British Columbia, Alberta and Saskatchewan to solicit rates of occurrence of badger injury to livestock. Of the 95 veterinarians surveyed, 11 reported treating animals injured in badger burrows within the past 5 years. Only 1 of 27 veterinarians from British Columbia reported encountering an injury due to badger burrows.

[1]Artemis Wildlife Consultants, 4515 Hullcar Road, Armstrong, BC V0E 1B4, Canada

[2]FORREX, Suite 702, 235 1st Avenue, Kamloops, BC V2C 3J4, Canada

[3]BC Ministry of Water, Land and Air Protection, PO Box 9338 Stn Prov Gov, Victoria, BC V8W 9M1, Canada, eric.lofroth@gems5.gov.bc.ca

# MONDAY EVENING PROGRAMS:

## 6:00 P.M. TO 8:00 P.M.

### MOUNTAIN LION CONSERVATION: PLANNING FOR THE FUTURE (LUMPKINS BALLROOM SOUTH)

Building on the presentations and panel discussions of the day, this meeting will explore the future of mountain lion conservation. Refreshments will be served, courtesy of the Mountain Lion Foundation.

## 6:00 P.M. TO 8:00 P.M.

### EDUCATION ROUNDTABLE (LUMPKINS BALLROOM NORTH)

### DEVELOPING RELEVANT WILDLIFE EDUCATION PROGRAMS: DO OUR EDUCATION PROGRAMS HELP WILDLIFE CONSERVATION EFFORTS, OR ARE WE JUST TALKING AMONGST OURSELVES?

This panel discussion will be moderated by Patrick Valentino of the California Wolf Center. Panelists will include: Carter Neimeyer, U.S. Fish and Wildlife Service; Walter Medwid, International Wolf Center; Minette Johnson, Defenders of Wildlife; and Camilla Fox, Animal Protection Institute. Audience participation requested!

Refreshments will be served, courtesy of the California Wolf Center and the International Wolf Center.

## 5:30 P.M. TO 7:30 P.M.

### BADGER CONSERVATION MEETING (LA TERRAZA ROOM)

Join badger advocates for a session of strategizing on badger conservation issues. A no-host dinner at a local restaurant will follow the meeting.

## 5:30 P.M. TO 7:30 P.M.

### CANID SPECIALIST GROUP MEETING (CORONADO ROOM)

Members of the IUCN's Canid Specialist Group welcome interested conference attendees to discuss issues in canid conservation and presentations on the CSG's two most recent publications.

## 6:00 P.M. TO 8:00 P.M. (BUS DEPARTS LA FONDA AT 5:45 P.M.)

**The Board of the Northern Jaguar Project cordially invites you to "The Ultimate Cat,"an art auction to benefit the preservation of Sonoran [northern] jaguars.**

Location: Bishop's Lodge, 1297 Bishop's Lodge Road

Cost: $25, Please dial 505-988-1234 or visit conference information desk to make reservations

Featuring: Musica Mexicana y Comiditas Tipicas de Sonora

Margaritas made with Sonoran Bacanora (Rare Local Tequila)

Appetizing Sonoran specialties

A panel of expert jaguar biologists and Sonoran field researchers, including Oscar Moctezuma, Executive Director of Naturalia, and Carlos Lopez, co-author of "The Jaguar" will be on hand to answer your questions regarding the nothernmost remaining population of jaguars and the amazing biodiversity of the Aros Bavispe area of eastern Sonora. The event will also feature Live and Silent Auctions with a wonderful array of Fine Arts and Crafts and Guided trips to the Jaguar Sanctuary. Dave Foreman, founder of Earth First! and The Wildlands Project will preside as auctioneer.

## 7:30 P.M. TO 10:00 P.M.

### DEVELOPING GUIDELINES FOR FISHER REINTRODUCTION (LA TERRAZA ROOM)

There have been and are currently several efforts at planning and conducting reintroduction efforts for the fisher, including those in Alberta, the northeast U.S., Idaho, Michigan, Colorado, Tennessee, Montana, Washington, Oregon and California. Taken together, these efforts provide a wealth of information on successful techniques and lessons learned. The workshop aims to use the collective knowledge gained from all of these efforts to develop general guidelines for fisher reintroduction. This meeting will be facilitated by Cynthia Wilkerson of Defenders of Wildlife, an ICA certified facilitator. The meeting will use participatory techniques to capture the suggestions of the group and organize them into clear, comprehensive, and concise guidelines that can be used by all conservation biologists engaged in fisher conservation efforts.

Please contact Cynthia Wilkerson at the conference registration desk or call 916-313-5810 to sign up for this workshop.

# ETHICS AND PREDATOR CONSERVATION

*Moderator: William Lynn*

## 1. A Predator's Nose Under the Tent: From Science to Ethics and Back Again

WILLIAM S. LYNN[1]

Recent meetings on terrestrial and marine wildlife evince a turn towards ethics in conservation science and policy. Scientists and advocates are increasingly aware that the conservation of predators is as much a social and ethical issue as it is a matter of ecological science. Even now we struggle with a fear and loathing of predators that is rooted in misinformation and self-interest. While ecological education mitigates these stereotypes, it is really a change in social values driven by education and ethical reflection that is the basis for a lasting solution. Yet there remains a mismatch between the science and ethics of carnivore conservation. The current dialogue emphasizes environmental policies built primarily on "sound science." Sound science is supposed to be the evidence-based, theory-rich, methodologically rigorous baseline for managing marine and terrestrial wildlife. Yet as previously noted, humanity's trouble with carnivores is deeply informed by conflicting values, which have little or nothing to do with empirical data, quantitative models, or management techniques. Instead, they are deeply rooted ethical conflicts over our coexistence with predators, large and small. Society needs, therefore, a "sound ethics" to complement our science, as well as to guide our conservation efforts. A sound ethics should, at a minimum, recognize the *moral standing* of predatory animals, highlight the *moral significance* of wildlife management, and emphasize the *practical value* of ethics in conservation. Finally, ethics should not exist in a biological vacuum, and needs science to help it discriminate between better and worse worldviews and actions.

[1]Practical Ethics, 95 Liberty Street, Beacon, NY 12508, williamlynn@practicalethics.net

# 2. Bringing Bioethics to Carnivore Conservation

CAMILLA H. FOX[1]

Bioethics incorporates fair and equal consideration of human and non-human interests in relation to ecological concerns such as environmental health, biodiversity, and C.P.R. (Conservation, Preservation, and Restoration). Many other fields that involve animal use address ethics and animal welfare, including animal research and livestock production, as well as animal behavior and applied ethology. Such considerations are often missing in science-based carnivore conservation strategies. To what degree should bioethical and animal welfare concerns and socio-cultural values be incorporated into carnivore management, conservation, and restoration efforts? What are the consequences for failing to consider such concerns and values? Wildlife managers and researchers often find themselves in the middle of polarized ethical debates with regard to carnivores, and sometimes it may appear easier to argue that bioethics, public opinion, and socio-cultural values have no place in scientific research or management. We must ask ourselves how ethical debate can strengthen efforts to restore and co-exist with large carnivores and help reach broader consensus among groups with divergent perspectives. Integrating bioethics into conservation efforts will be critical for ensuring continued survival of large carnivores in the face of a rapid social and ecological change.

[1]Animal Protection Institute, P.O. Box 22505, Sacramento, CA 95822, chfox@earthlink.net

# 3. Predator Paranoia and the Politics of Culling Marine Mammals

DAVID LAVIGNE[1]

As demonstrated in the research of Stephen Kellert and others, human attitudes towards predators (including marine mammals) vary widely, from negativistic to utilitarian to moralistic. Predator conservation is thus as much a matter of ethical choice as it is of scientific research. Controversy arises when values are in conflict, and the mechanism we have for resolving such conflicts — politics and the public policy process — are inadequate. In the resulting political debate, science is misused and abused by the participants in the hope of attaining goals that, in reality, have nothing whatsoever to do with science. The current Japanese and Norwegian calls for culling marine mammals is a timely example.

[1]International Fund for Animal Welfare, 1474 Gordon Street, Guelph, ON N1L 1C8, Canada, dlavigne@ifaw.org

# 4. The Predator's Koan: Which Cog Turns the Wheel?

FRED W. KOONTZ[1]

There appears to be a growing realization among conservation biologists that improving scientific understanding alone does not change public policies — especially in emotionally laden areas like predator management ñ and that stakeholder discourse crafted to integrate accurate facts, expert opinions, and societal values is the best strategy for guiding public policy. A formidable dilemma that practitioners of this approach face is reconciling differences between systems-thinking scientists and individual-animal-centered animal advocates. Many environmental scientists today focus on higher-level categories of ecological organization (e.g. natural communities, ecosystems, and ecological health) because of a growing appreciation of biocomplexity. Animal advocates, on the other hand, mostly focus on lower levels of ecological organization (e.g. species and individual animals), because our collective moral judgment toward wildlife is expressed primarily through a legal system that addresses only these lower organizational levels. Consequently, in initial conversations among policy stakeholders misunderstandings often erupt over science and values, when the conflict really is due to differences in the apparent (and real) value weightings assigned to ecological levels by scientists and animal advocates. To move forward, I suggest that: (1) scientists more fully appreciate that individual animals count when making policy and that many more facts are needed about the biology of individuals (e.g. animal cognition and mental awareness); (2) animal advocates should collaborate with environmental ethicists to implement a conceptual framework that includes moral sensibilities at all levels of ecological organization; and (3) civic leaders define consensus policies by "informed community imagining" of likely outcomes to ecological health, including the health and well-being of people, among various policy options. Developing predator conservation policy is well suited for such an approach — and provides an ideal example for finding a middle path by blurring the ecological categories and appreciating simultaneously the parts and the whole.

[1]Wildlife Trust, 61 Route 9W, Palisades, NY 10960, Koontz@wildlifetrust.org

# BLACK-FOOTED FERRET RECOVERY

*Moderator: Minette Johnson*

## 1. Biomedical Survey of Wild Black-Footed Ferrets

JOGAYLE HOWARD[1], SAMANTHA M. WISELY[2], RACHEL M. SANTYMIRE[1], TRAVIS M. LIVIERI[3], J. S. KREEGER[4], P.E. MARINARI[4], D.E. WILDT[5] AND E.S. WILLIAMS[6]

The recovery of the black-footed ferret (*Mustela nigripes)* is one of the most ambitious breeding and reintroduction efforts in conservation. Rescued from the brink of extinction with only 18 animals remaining, this North American carnivore now has ~700 individuals in the combined *ex situ* and *in situ* population. Black-footed ferrets have been reintroduced into Wyoming, South Dakota, Montana, Arizona, Colorado, Utah and Mexico on lands managed by federal and state agencies, private landowners and tribal councils. Yet reintroduction "success" to the western Great Plains has been varied. To evaluate factors influencing survival, an extensive multi-disciplinary biomedical survey of wild black-footed ferrets has been initiated. From September 2002 through April 2004, 164 wild black-footed ferrets (87 males, 77 females; 151 wild-born, 13 captive-born) were captured at reintroduction sites in Wyoming (n=19), South Dakota-Conata Basin (n=123), South Dakota-Cheyenne River Sioux Reservation (n=6), Montana (n=2), Utah (n=2) and Mexico (n=12). Each animal was anesthetized for a health examination and blood collection, then returned to the capture site. A serological survey assessed antibodies to sylvatic plague (*Yersinia pestis*), tularemia (*Francisella tularensis*), toxoplasmosis (*Toxoplasma gondii)* and canine distemper virus. All ferrets lacked antibodies to sylvatic plague. Tularemia and toxoplasmosis were detected at Conata Basin only, and six animals had exposure titers. Antibodies to canine distemper were not detected in unvaccinated animals, and protective titers were observed for at least 6 months following one injection of the recombinant vaccine Purevax®. To date, results demonstrate the susceptibility to the potentially fatal sylvatic plague and the need for distemper vaccinations in the reintroduced black-footed ferret populations.

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# 2. Reintroduction of the Black-Footed Ferret at the Southern Limit of the Black-Tailed Prairie Dog Distribution

JESUS PACHECO[1], RURIK LIST[1] AND GERARDO CEBALLOS[1]

The prairie dog ecosystem is critically endangered as a functional ecosystem; many of its associated species has been reduced in distribution and number. Beginning in 2001, the black-footed ferret (*Mustela nigripes)*, one of the most endangered mammals in North America, has been reintroduced at the southern limit of the black-tailed prairie dog distribution in Mexico. The ferret release area is located in the northwestern Chihuahua, 75 km from the USA — Mexico borderline, in the Janos-Casas Grandes Complex (JCGC), the largest (20,000 ha) contiguous colony of black-tailed prairie dogs found in North America. It is one of nine sites across North America were ferrets have been released. There have been a total of 239 black-footed ferrets released. Located ferrets were either identified by the use of transponder readers and/or trapped. Wild-born ferrets were marked with two transponders for future identification. The total number of positively identified ferrets released since 2001 was 32 (15 male and 17 female). The total numbers of positively identified wild born ferrets were 12. The comparatively reduced number of ferrets observed during the surveys could be due to three factors: 1) high mortality and low reproduction; 2) reduced above ground ferret activity; and 3) increased ferret dispersal as a result of the prairie dog town size. Due to its size, the Janos prairie dog town represents a unique opportunity for ferret recovery in the wild.

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# 3. The Effect of Prairie Dog Density and Owl Predation on Survival of Reintroduced Black-Footed Ferrets

STEWART W. BRECK[1], TRAVIS M. LIVIERI[2] AND DEAN BIGGINS[3]

Black-footed ferrets (*Mustela nigripes*) are one of the most endangered mammal species in the world. Reintroduction efforts to recover black-footed ferrets began in 1991 and continue today. The success of these reintroduction campaigns (i.e., high survival rates of reintroduced animals) is important for recovery. It is known that the type of rearing ferrets receive prior to release influences survival of reintroduced ferrets. However, it is likely that other factors such as densities of prairie dogs (*Cynomys spp*.) and presence of predators also influence survival. We present short-term (14 days) and long-term (1 year) survival data from reintroduction efforts at 3 release sites in South Dakota (Agate, Burns, and Sage) where 14, 24, and 18 ferrets were released, respectively. Rearing strategy and management of coyotes (*Canis latrans*) with electric fencing was the same for all reintroduced animals. The sites differed in densities of prairie dogs (Sage=32.6, Agate=24.9, Burns=8.7 prairie dogs/ha) and in the impact that great horned owls (*Bubo virginianus*) had on survival or ferrets. Short-term and long-term survival were dramatically higher on Sage (short-term: 0.91, long-term: 0.47) than on Agate (short-term: 0.48, long-term: 0.08) or Burns (short-term: 0.48, long-term: 0.08). Of the known causes of mortalities, owls were responsible for 44% on Agate, 27% on Burns, and 0% on Sage. Higher densities of prairie dogs and removal of a few owls when they develop a search image for ferrets may enhance survival of reintroduced ferrets.

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# 4. Selection of Prairie Dog Colonies by Black-Footed Ferrets in South Dakota

TRAVIS M. LIVIERI[1], E. M. ANDERSON[2], M. R. MATCHETT[3] AND W. PERRY[4]

Black-footed ferrets (*Mustela nigripes)* are obligate predators of prairie dogs (*Cynomys spp.*) and occur only on prairie dog colonies. However, all prairie dog colonies do not represent equally suitable habitat for ferrets. We used logistic regression to construct resource selection probability function (RSPF) models of ferret selection of prairie dog colonies in South Dakota during three successive selection periods, short-term (30-180 days post-release/dispersal), long-term (180+ days post-release/dispersal), and litter production. Prairie dog colonies inhabited by ferrets were compared to uninhabited colonies. The preferred models indicate size of the prairie dog colony (AREA) and area-weighted inter-colony distance (MDIST) were significant variables in all three models. Long-term and litter selection models applied to an independent data set of reintroduced ferrets in Montana correctly predicted more than 80% of the use/nonuse of those colonies. Results suggest prairie dog colony attributes are useful in predicting relative levels of ferret habitat quality. These models provide insights into ferret habitat quality at reintroduction sites and could be used in designing prairie dog reserves for ferret reintroduction.

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# CARNIVORES AND HUMANS: ATTITUDES, POLICY AND MANAGEMENT

*Moderator: Suzanne Stone*

## 1. Predator Control in Alaska: An Analysis of Current Predator Control Programs and the Recommendations of the 1997 National Research Council Report, *Wolves, Bears and Their Prey in Alaska*

VIC VANBALLENBERGHE[1], DAVID R. KLEIN[2], KAREN DEATHERAGE[3]

Alaska's Intensive Game Management law requires game species such as caribou, moose and deer be managed for "high levels of consumptive use" and that the Alaska Board of Game set the necessary management directives to meet population and harvest objectives. As a result, both state sponsored ground-based and airborne predator control programs were conducted in Alaska until the early 1990's. In 1995, a controversial wolf snaring program was suspended by Governor Tony Knowles, who then commissioned the National Academy of Sciences (NAS) to prepare a scientific and economic review of management of Alaska's wolves and bears. The NAS report, *Wolves, Bears and Their Prey in Alaska*, assesses the ecological, economic and political contexts in which Alaska's predator control programs are carried out.

During the winter of 2004, Alaska resumed state-sponsored predator control, and implemented two aerial wolf killing programs in interior Alaska which resulted in the lethal removal of 147 wolves. Wolf control in these and additional areas encompassing 30,000 square miles is expected to continue for the next four to five years, and will result in the killing of thousands of wolves. Also part of the program, grizzly and black bears are being relocated from the McGrath area to assist in augmenting moose calf survival. Defenders of Wildlife and many in the scientific community believe Alaska's current predator control programs do not meet the recommendations of the NAS report. We will look at whether or not existing research and management data provide a sound scientific basis for wolf control in Alaska, and if the programs make economic and ecological sense. We will also address the political ramifications of lethal aerial control, and what, if any, conflict resolution process is in place to address this highly controversial issue.

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# 2. Wolves: Persecution, Science and Their Intrinsic Value

KARLYN ATKINSON BERG[1]

This presentation will explore the relationship between humans and wolves and how historic and complex cultural images still influence our interactions with the wolf. Do antiquated attitudes still shape management convictions and fuel efforts to return to extensive lethal wolf control? The striking lack of human tolerance is not commensurate with the low number of depredation problems wolves actually cause. In spite of the insistence that modern management is solely based upon science, these management plans call for loading up the same guns and setting out the same traps that brought about the wolf's demise only a few decades ago. Management plans refer to how many wolves can be freely killed rather then how few problem wolves might need to be removed to solve conflicts. Can our interrelation with the wolf be conceived only within a narrow scientific depiction? The author believes that science alone cannot satisfy the many other ways humans experience the world, which includes aesthetic and moral values. Wolf science has increasingly become concerned with a pragmatic framework that insists upon measuring everything in terms of what humans have defined as important for themselves. Lamentably, wisdom, ecological conscience and ethics are overshadowed by the constraints of this limited vision. The majority of the public cares about wildlife, not for their biological necessity but because of their intrinsic value. The unwillingness of some humans to coexist with wolves should not be used as scientific measure of how many wolves are allowed to exist.

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# 3. Testing the Ambassador Population Hypothesis

CURTIS D. BJURLIN[1] AND BRIAN L. CYPHER[1]

As natural lands continue to be converted to human uses, the general public is at risk of becoming alienated from wilderness and the plight of endangered species. Support for conservation may consequently decrease, creating a feedback loop that causes further habitat and species losses. We suggest that "ambassador populations" of charismatic species will help to break the feedback cycle and facilitate public dialogue regarding wildlife conservation. An ambassador population is defined as one that receives disproportionate exposure and interest, media representation, and conservation or research funds. We hypothesize that access to an ambassador population affects citizen knowledge, attitudes, and conservation ethic. We test this hypothesis by contrasting the responses on a questionnaire regarding San Joaquin kit foxes (Vulpes macrotis zinseri) that we administered to residents of two large urban centers, Bakersfield and Fresno, California. Both cities are within the range of this endangered fox, but only Bakersfield supports an urban fox population. In a preliminary survey, Bakersfield residents had significant personal interaction with urban kit foxes (70.4%) that affected knowledge and attitudes regarding the species. The conditions necessary for ambassador populations likely exist in many ecoregions (wolves of Yellowstone National Park and polar bears of Churchill, to name a few established examples) and the importance of these populations as a source of citizen knowledge and goodwill may warrant additional public access and special conservation status.

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# 4. Attitudes Toward Wildlife Management of Black Bears in Missoula, Montana*

MELINDA M. BOOTH[1]

The Rattlesnake neighborhood in Missoula, Montana is surrounded on three sides by undeveloped, wild land. One side is permanent open space, one is held privately but yet undeveloped and the other is the gateway to the Rattlesnake Wilderness Area. Black bears (*Ursus americanus*) have always inhabited this valley, but bear-human interactions have increased drastically here since the mid 1990s and management of the situation continues to be controversial. A majority of the interactions revolve around garbage and residents' general negligence when it comes to bear attractants. My study surveys residents in the Rattlesnake about their normative beliefs to determine acceptability of bear management actions based on the increase in bear-human interactions in the last ten years.

I hypothesize that people's normative beliefs about management actions will be influenced by two variables: the severity of the incident and the proposed management action. The public must approve policy and management actions in order for them to be successful and knowing what people deem acceptable is hard to determine. Knowing the residents' attitudes toward the management of bears in the Rattlesnake will help the state agency, Montana Fish, Wildlife and Parks, create a strategy for human/bear co-existence that more people can agree with and one to which they can voluntarily comply. Conducting a normative survey of the residents will help determine the acceptability of management actions making management of the bears in the Rattlesnake more successful for both bears and humans, especially as development continues in the valley.

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# 5. Humans As the Key Mega-Carnivore Environmental Factor

WENDEL J. JOHNSON[1]

The growth and distribution of the human population will be illustrated as the key factor in diminishing mega-carnivore numbers and distribution. Historical and present-day examples will illustrate in detail the detrimental collide of increasing human numbers and mega-carnivore survival. Suggestions to rectify and/or ameliorate this environmental pressure on large wild carnivores will be presented.

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# GRIZZLY BEARS

*Moderator: David Mattson*

## 1. Grizzly Bear Recovery: A Progress Report After 23 Years

CHRISTOPHER SERVHEEN[1] AND WAYNE KASWORM[2]

The grizzly bear (*Ursus arctos horribilis*) was listed as a threatened species under the Endangered Species Act in 1975. Six areas were identified in the 1975 listing as grizzly bear populations. Organized recovery efforts have been underway since 1981. The Interagency Grizzly Bear Committee, representing state, federal, tribal, and county interests, implements the recovery program. The recovery program is a cooperative multi-agency effort with full state, federal, tribal and public participation. Significant progress has been made in the recovery of the Yellowstone and Northern Continental Divide populations. The situation in the four other ecosystems is much less positive. Grizzly bear populations spanning the U.S.-Canada border in the Cabinet/Yaak and Selkirk ecosystems are small and vulnerable, and occur in the southernmost extensions of Rocky Mountain habitat extending down from Canada. The North Cascades grizzly population is isolated on both the U.S. and Canadian sides and is considered the most endangered grizzly population in Canada. An attempt to begin to reintroduce grizzlies into the Bitterroot ecosystem in 2000 was blocked by certain political interests. Aggressive conservation measures are necessary to recover these populations including augmentation with additional bears, mortality reduction programs, public outreach, and reestablishment of population linkages so these areas are no longer isolated. We are working on enhanced cooperative U.S. and Canadian efforts to address the issues facing these small grizzly populations and to build connectivity to existing larger populations and areas of vacant habitat. Limitations to grizzly recovery are funding and political resistance and interference. We believe it is possible to recover grizzly bears all of the 6 areas where they were thought to exist in 1975 if funding, agency and political commitment, and public support are present. The success of the Yellowstone recovery effort is proof that a cooperative effort can recover a grizzly population. We know what to do to help the remaining populations and we can do it, if we are given the opportunity.

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# 2. A Collaborative Science-based Approach to Grizzly Bear Conservaton in the U.S.-Canada Transborder Area

STERLING D. MILLER[1] AND THOMAS FRANCE[1]

Three critically important grizzly bear (*Ursus arctos*) populations in southern British Columbia and adjacent areas in northwestern Montana (the Cabinet-Yaaks/Purcells), northern Idaho (Selkirks), and northwestern Washington (North Cascades) have extremely small and endangered populations on both sides of the border. Although other U.S. populations of grizzlies in Yellowstone and Glacier Parks have increased, these transborder populations have remained numerically stagnant in recent decades. The National Wildlife Federation and state and federal wildlife agencies organized a workshop in Sandpoint Idaho to explore the available science illustrating the recovery-impeding factors that must be addressed for these populations. This workshop included opportunities to create dialogue between agency staff, environmental groups, local citizens, and local political leaders. The peer-reviewed proceedings of the workshop were published in 2004 in the journal *Ursus*, and this volume provides the information base necessary to advance recovery efforts. In this presentation, we present key findings presented in these workshop manuscripts and outline plans for the future collaborative conservation efforts.

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# 3. *Bear With Us*: An Alternative Path to Grizzly Recovery in the Lower 48 States

LOUISA WILLCOX[1]

In May 2004, Natural Resources Defense Councils Wild Bears Project completed *Bear with Us: An Alternative Path to Grizzly Recovery in the Lower 48 States*. This document is based on new information and analysis on grizzly (*Ursus arctos*)habitat needs in the Northern Rockies and adjacent ecosystems in Canada, as well as on over twenty years of experience solving problems with grizzlies in the region's human communities. This document outlines an optimistic vision: that there is still time to restore the threatened grizzly, but only by adopting a broader vision of bigger connected ecosystems, protecting ecosystems large enough to account for likely environmental changes, and learning from the past successes and failures in efforts to resolve human-bear conflicts. Recent research reveals that there is still room enough to reach a population of 3,000 grizzlies (roughly twice current numbers) by reconnecting grizzlies in Yellowstone to Canadian source populations, and by restoring grizzlies to the now vacant Selway Bitterroot Ecosystem.

This document applies extensive scientific knowledge about the ecology and biology of the grizzly and practical conservation context highlighting stories of how human-bear conflicts have been successfully resolved. It recognizes the need to work at different scales and on multiple fronts because of the way that grizzlies use landscapes, and how and where they die. It also stresses the importance of humility in grizzly management in the face of environmental change such as global warming trends, and asks why the federal government is proposing to prematurely delist the grizzly in Yellowstone, before long-term recovery has been achieved.

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# 4. Delineation of Population and Sub-Population Boundaries of Grizzly Bears in Southwestern Canada Using Genetic Analysis

MICHAEL F. PROCTOR[1], BRUCE N. MCLELLAN[2], CURTIS STROBECK[3] AND ROBERT M.R. BARCLAY[4]

Meta-population structure may develop from combinations of natural fractures and anthropogenic population fragmentation. The detection of biologically-based population boundaries and their causes is necessary to understand and effectively manage these fragmented systems. We describe the human-induced meta-population structure of grizzly bears (*Ursus arctos*) in southwestern Canada as derived through genetic analyses. We used 15 locus microsatellite genotypes of 813 wild grizzly bears across 100,000 km$^2$ of southwestern Canada and two levels of analysis that provide insight into the structure and genesis of population boundaries in this system. First we used individual-based population assignment methods and multiple linear regression to measure sex-specific movement rates and fragmentation in relation to human disturbance. Second, we used a Baysian Monte Carlo Markov Chain algorithm designed to detect population boundaries with no a priori assumptions of group membership. Together these results suggest where spatially explicit discontinuities exist in the regional distribution of grizzly bears sufficient to detect and explain the presence of population and sub-population units. We identified seven immediately adjacent sub-populations characterized by limited female and varying degrees of male inter-change and one isolated population. The future of grizzly bear persistence in southwestern Canada is likely dependent on management actions that promote and ensure meta-population function (inter-change of males and females) between these fragmented sub-units. Our results lay out the regional structure, and suggest direction for workable, realistic, and necessary management actions.

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# 5. Comparing Alternative Representations of Available Habitat and Framing Bias in Resource Selection Models*

THOMAS R. ETHERINGTON[1] AND SHELLEY M. ALEXANDER[1]

Framing bias occurs when there is a mismatch between the spatial extent of measurement of a phenomena and the extent of spatial analysis. A hierarchy of frames which should be used to outline an appropriate spatial extent are defined. We illustrate this approach through the analysis of grizzly bear (*Ursus arctos*) radio-telemetry data for resource selection, and examined the potential for disagreement between three methods. We first defined the study frame (area where results are applied) and survey frame (where surveys were logistically possible). We then used three methods to define the area of selection (where non-occurrence accurately reflects non-use), which included a minimum convex polygon, a kernel density estimator, and a simple buffer approach. Finally, we defined three analytical frames (overlap between the survey frame and selection frames) as appropriate extents for spatial analysis. Using logistic regression and Akaike's Information Criteria we compared how resources were interpreted between analytical frames, and applied optimal models to the study frame to compare probability surfaces. We found that each method interpreted the selection of resources differently, though road density and greenness were consistently important, and produced varying estimates of resource use potential, with mean cell probability ranging from 0.328 to 0.451, constituting a 37.5% increase between two approaches. In areas with steep resource gradients, such as within mountains, the choice of analytical frame is likely most critical. The inherent variability resulting from framing bias warrants the explicit description of analytical frame, such that results may be used and interpreted accurately.

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# 6. Last Stand: The Decline And Recovery Of Alberta's Threatened Grizzly Bear

JEFF GAILUS[1]

This presentation will detail the historical decline of Alberta's threatened grizzly bear (*Ursus arctos*) population, highlight the limiting factors that leave its future uncertain, assess the effectiveness of the provincial recovery plan, and provide recommendations on what is necessary to ensure a future for Alberta's grizzly bear.

Although it has yet to be listed as such, Alberta's grizzly bear has been a threatened species for decades. Excessive rates of human-caused mortality, habitat alteration and fragmentation, and the unsustainable management of natural resources have led to the decline of the Alberta grizzly bear population. As of 2002, only 500 individuals roamed some 230,000 km$^2$ in western Alberta. Despite the fact this information was known and understood at least as far back as 1988, politicians and agencies in Alberta have done little or nothing to prevent the grizzly bear's continued slide toward extinction — until now.

Since the Alberta Endangered Species Conservation Committee recommended to the provincial government that the grizzly bear be listed as a threatened species in 2002, the government has reluctantly begun to look into the possibility of recovery. While it hasn't listed the grizzly bear as a threatened species — the first time in history the government hasn't followed the recommendation of the AESCC — it has increased poaching fines, attempted to reduce the number of bears killed during the grizzly bear hunt, and set up a recovery planning team. The recovery team has been working on a recovery plan for the last year, and a draft is due to be completed by the fall.

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# ECONOMICS OF CARNIVORE CONSERVATION

*Moderator: Frank Casey*

## 1. The Role of Economics in the Recovery and Conservation of Endangered Species and Their Habitats

FRANK CASEY[1]

Economic analysis is increasingly becoming an integral part of policy formulation and conservation strategies for the recovery and conservation of endangered species and their habitats. Government agencies and private organizations are utilizing economic analyses for determining the size and location of critical habitats for recovery, the benefits and costs of recovery and conservation efforts, and the level and targeting of incentive programs. This presentation will provide an up-to-date assessment of how economics has been applied to various species and habitat conservation studies and programs. Topics to be addressed will include conservation finance, valuing conservation of wildlife habitat and eco-system services, economics of incentive programs, and the various costs and benefits that should be considered by policy makers in conservation and recovery planning. Both public and private, market and non-market values and incentive mechanisms will be discussed. A brief synopsis of methodological developments will be presented. The presentation will serve as the introductory piece for the session on conservation economics that will feature the results from specific studies related to the benefits of sea otter recovery, the economic impacts of designating critical habitat for the lynx, and eco-tourism incentives for red wolves.

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# 2. Economic Benefits to California Residents of Southern Sea Otters

JOHN LOOMIS[1]

Expansion of southern sea otter populations and habitat will result in more than one hundred million dollars in annual economic benefits to California households. These benefits include recreation, existence values, option values, ecosystem services and tourism. The majority of these benefits arise from existence values from just knowing that sea otter populations would be prevented from extinction and their populations could increase to the level were it could be removed from the Endangered Species List. These results are based on an existing survey by San Diego State University for National Marine Fisheries Service. This survey of California households asked these households willingness to pay for three different levels of sea otter populations. The benefits of increasing sea otter populations from their recent average population of 2,150 animals (U.S. Fish and Wildlife Service, 2003) to the recovery goal of approximately 3,000 animals is at least $26 million and may be as high as $250 million.

Expansion of southern sea otter populations and habitat will likely result in increases in tourism in Santa Barbara in the next decade, and eventually in Ventura County as well as the rest of Southern California over the next several decades. We estimate at least 56 direct jobs to as much as 256 direct jobs associated with the U.S. Fish and Wildlife Service (USFWS) Supplemental Environmental Impact Statement (SEIS) estimates of additional otters in Santa Barbara county in the next decade. At least 1,400 jobs to as many as 8,400 direct jobs would be supported by tourism associated with an eventual increase in sea otter populations to carrying capacity along the Southern California coast. Sea otter related tourism income would be about $7.4 million annually in Santa Barbara and Ventura counties from the initial expansion of sea otter populations envisioned by U.S. Fish and Wildlife Service. Eventually, as sea otters expand their range throughout Southern California, tourism related income would increase by $176 million.

Sea otters are also a keystone species in sustaining healthy kelp forests off the California coast. These kelp forests provide many valuable services, directly and indirectly, to humans. These services include reduced shoreline erosion, improved habitat for numerous invertebrates such as mussels and clams, several fish species, as well as carbon storage that can moderate climate change. The expansion of sea otter populations will aid in the restoration and maintenance of kelp forests off the coast of Santa Barbara, and eventually the rest of the southern California coast. The ecosystem services of kelp forests have been valued by other scientists at $7,600 per acre per year.

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# 3. Economic Impacts of Designating Critical Habitat for Lynx

TIMM KROEGER[1], FRANK CASEY[1], MICHAEL CHAVEAS[3] AND JOHN SLACK[4]

The designation of critical habitat by the U.S. Fish and Wildlife Service (FWS) plays a crucial role in the recovery of threatened and endangered species. By design, the designation of critical habitat limits some uses of the designated lands. These use restrictions form an important part of the impacts of designations, and they carry associated costs and benefits.

Historically, complaints by the regulated community about the costs of designation have tended to direct much attention on the negative impacts of designated critical habitat; specifically, on the land uses restricted by the designation. The other side of the ledger, the benefits that critical habitat generates for land uses that compete with restricted uses, has generally received much less attention. This is due to the complete lack of monetized benefit estimates in FWS' published studies that analyze the impacts of critical habitat designation. Unfortunately, the exclusive economic focus on the cost side of designation of critical habitat impacts has supported a drive to weaken the Endangered Species Act's stringent designation requirement. If those attempts were to succeed, the likely result would be a decrease in the chances of recovery of many endangered and threatened species.

This study argues that the justifications advanced by the FWS for excluding the benefits of critical habitat designation from monetization are not valid. To show that defensible value estimates of such benefits can be generated with an effort comparable to that commonly expended on the generation of cost estimates, we conduct a comprehensive economic impact analysis for the designation of critical habitat for the lynx (*Lynx canadensis*), a listed species that currently is awaiting such designation. In addition to estimating the costs of designation, we employ standard environmental economics methodologies, including cost-benefit analysis methodology and standard valuation techniques to estimate the full range of economic benefits of designating critical habitat.

Our analysis demonstrates that conceptually complete economic analyses of the impacts of designation of critical habitat are feasible, if one accepts uncertainties in the benefits estimation that are comparable to those that characterize the cost estimates of the FWS's analyses of designation.

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# 4. Red Wolves: Creating Economic Opportunity Through Ecotourism in Rural North Carolina

GAIL Y.B. LASH[1], NINA FASCIONE[2], FRANK CASEY[2] AND PAMELA BLACK[1]

In October 2003, Defenders of Wildlife received a grant from The Walker Foundation to examine the capacity of rural landowners and hunters in northeastern North Carolina to develop new ecotourism opportunities as a way to bring economic benefits and promote positive attitudes towards red wolf (*Canis rufus*) conservation. Our objectives are to improve the economic status of the surrounding counties, encourage participatory decision-making within the community, and provide an incentive for the conservation of endangered red wolves. Researchers are conducting an assessment of the ecotourism potential in rural northeastern North Carolina through a market demand study of tourists visiting the Outer Banks, as well as investigating capacity by local residents. These activities entail examining the attitudes and awareness of red wolves and tourism, conducting an economic assessment, and developing strategies for sustainable ecotourism development within the framework of a viable market plan. Through this analysis, we hope to assist rural residents in understanding and modifying their enterprises to match tourist demands, and create ecotourism packages that are truly beneficial for both people and wildlife. This research will result in a report, expected by fall, 2004 that will outline ecotourism potential and a gameplan for infrastructure and training.

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# 5. Spending on Recovery: Compensation Costs for Livestock Depredation by Gray Wolf in the Northern Rockies

JAMES CHRISTOPHER HANEY[1], SUZANNE A. STONE[2], GINA SCHRADER[1], FRANK CASEY[1]

From 1995 through 2003, Defenders dispersed over $330,000 in payments to more than 250 ranchers for reported episodes of wolf depredation on livestock in Wyoming, Montana, Idaho, and Utah. Annual compensation scaled to: 1) size of the wolf population, 2) number of verified claims, and 3) market prices of livestock based on age, sex, breed, and claim status. Confirming forecasts made before reintroduction, wolf depredation was density-dependent (more strongly for cattle than for sheep), fewer cattle than sheep were taken per depredation episode, and depredation peaked during late summer and fall. For all projections except cattle in Greater Yellowstone, however, verified depredation was only 64-86% of averages predicted by the pre-release environmental impact statement (EIS). For sheep and cattle in both Central Idaho and Greater Yellowstone recovery areas, cumulative verified depredations were 32-79% of maxima projected in the EIS. Livestock depredation was positively correlated with same- or previous-year number of wolves killed plus relocated, providing no evidence that these measures provided short-term mitigation when aggregated across the entire recovery area. Unit costs for compensating cattle (but not sheep) depredations leveled off or declined after 1999, when proactive methods to mitigate depredation were first implemented widely. Over nine years, annualized unit costs for all livestock losses combined were lowest in the remote Central Idaho recovery area ($78.07/wolf/year) and highest in the Greater Yellowstone recovery area ($116.19/wolf/year). Any fixed (or predictable) costs should facilitate the fiscal planning of compensation programs administered for endangered carnivores.

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# WILDLIFE GENETICS

*Moderator: Len Ruggiero*

## 1. The Importance Of Genetics For Managing Carnivores

STEVE CHAMBERS[1]

Molecular genetics has given us dramatic new insights on how to manage carnivores. Most large projects involving carnivores have some genetic component. However, with the explosion of new techniques and molecular methodologies being developed every week there are some hidden pitfalls which managers, biologists, and scientists must be aware of. This symposium first establishes the huge benefit that can be derived from obtaining genetic information on carnivores and then discusses issues such as gene flow, hybridization, and evaluation of Evolutionary Significant Units with respect to both the problems and potential solutions of using these methods.

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# 2. Hybridization in Threatened and Endangered Carnivores

MICHAEL K. SCHWARTZ[1], LEN RUGGIERO[1], KRISTY PILGRIM[1], ED LINQUIST[2], AND KEVIN MCKELVEY[1]

Hybridization between taxonomically similar species is an often-overlooked mechanism limiting the recovery of threatened and endangered species. New tools both in the genetics laboratory and using computer simulation provide unprecedented power to detect hybridization. In this talk we provide an overview of carnivore hybridization and then describe work we have conducted demonstrating that rare Canada lynx and common bobcats hybridize in the wild. Specifically, we verified that two microsatellite loci have nonoverlapping allele ranges between Canada lynx and bobcats, and that three putative lynx from Minnesota contain DNA from both bobcats and lynx. In addition, samples from other regions in North America have shown evidence of hybridization. We place these data in an ecological context. Overall, hybridization may be an under-appreciated factor in limiting the geographic distribution and recovery of threatened and endangered carnivores.

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# 3. Recent History And Connectivity Of Cougar Populations: Can A Virus Tell The Story?

ROMAN BIEK[1] AND MARY POSS[2]

Population structure and connectivity in carnivore populations are commonly assessed using genetic techniques but results may often reflect historic rather than current situations. We are proposing the use of a benign but rapidly evolving retrovirus to examine the population structure of its carnivore host in the present. As a case study, we present genetic data from cougar populations and their viruses in the northwestern US and Canada. Virus data indicate limited population admixture and recent expansion of cougar populations in recent decades consistent with cougar numbers currently rebounding from heavy persecution in the past. By allowing inferences about processes and time horizons usually not obtainable with other methods, measurably evolving viruses represent a unique genetic tool that is complementary to existing approaches.

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# 4. Methods to Identify and Remove Genotyping Errors From Non-Invasively Collected Genetic Tags

KEVIN MCKELVEY[1] AND M. K. SCHWARTZ[1]

Capture-mark-recapture (CMR) estimates assume no misidentification of individuals captured and are extremely sensitive to identification errors. A large body of published literature has demonstrated that non-invasively derived genetic tags are error-prone, and the potential biases associated with these errors are large. Given the presence of a variety of errors in genetic tags, and the potential for large biases associated with these errors, we argue that scientific norms require formal tests to demonstrate the absence of errors. We present methods to reduce and evaluate these errors, and to demonstrate that, for purposes of CMR estimation, a molecular data set is error free.

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# 5. Reintroduction History Affects Genetic Diversity and Morphology of the Black-Footed Ferret

SAMANTHA M. WISELY[1], RACHEL M. SANTYMIRE[2], TRAVIS M. LIVIERI[3], AND JOGAYLE HOWARD[2]

Population genetic theory predicts that bottlenecks reduce genetic diversity, increase inbreeding and potentially decrease fitness via inbreeding depression. To determine if reintroduction history had genetic or phenotypic consequences, we measured genetic diversity and morphometry of two reintroduced populations of black-footed ferrets (*Mustela nigripes*) which underwent different population trajectories during establishment. In Shirley Basin, Wyoming, 228 animals were released over 4 years and the population remained at low levels. In Conata Basin, South Dakota, 147 animals were released over 4 years and the population underwent exponential growth. Using five microsatellite loci, expected heterozygosity was 0.31 for the donating captive population (n = 36), 0.43 for South Dakota (n = 41), and zero for Wyoming (n = 11). We measured 9 morphological characters on live, anesthetized, adult black-footed ferrets from both reintroduction sites. We reduced the nine variables to one principal component (PC1) which we interpreted as body size. Using sex and location as treatment groups, a two-factor ANOVA of PC1 revealed that Wyoming had significantly smaller animals than South Dakota ($F_{2,28} = 3.9$, $P = 0.03$). Males were on average 4% smaller and females were 2% smaller in Wyoming than in South Dakota. The persistent population bottleneck in Wyoming reduced genetic diversity to an undetectable level while South Dakota maintained levels comparable to the captive population. The high level of inbreeding experienced by the Wyoming population may have contributed to the diminutive body size.

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# CARNIVORE MANAGEMENT IN RECREATION AREAS

*Moderator: Karen Deatherage*

## 1. Reducing Human - Bear Conflicts in the Tahoe Basin: Conservation through Community Alliance

CYNTHIA WILKERSON[1]

Conflicts between humans and bears (*Ursus americanus*) in the Lake Tahoe Basin have increased dramatically in the past decade, corresponding with an increase in the resident and visiting tourist population in the region. Defenders of Wildlife has been working with the Tahoe Council for Wild Bears (TCWB) for the past several years to reduce these conflicts. TCWB is an alliance of local, state and national conservation organizations, agencies, residents, and businesses that joined forces in late 2001 to develop methods to reduce the region's human-bear conflicts. In 2003-2004, TCWB implemented an innovative education campaign which included: 1) purchasing and installing 130 commercial bear-proof dumpsters in the most conflict-prone areas; 2) publishing and distributing "Bear Aware" brochures; 3) establishing an informative website; 4) printing "Bear Aware" grocery bags distributed in regional Safeway stores; 5) developing and presenting a Bear Aware slide show for multiple community venues; and 6) conducting media outreach. This program was extremely successful in reaching its stated goals of: 1) reducing human-bear conflicts at commercial dumpsters in the Tahoe City/ West shore region by 90% and 2) reaching 25-30% of Tahoe residents and visitors with the Bear Aware education campaign. Ongoing Defenders' work in this region focuses on the passage and effective implementation of bear-proof ordinances at the county level. Conservation of wildlife prone to human conflicts will require similar alliances and diverse projects in order to succeed.

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# 2. Managing Bears and People in the Greater Yellowstone Ecosystem: Critical Steps for Implementing Food Storage and Sanitation Efforts in National Forests

TIMMOTHY KAMINSKI[1], S. M. PRIMM, K. L. BARBER, S. MARSH, B. SCHWEITZER, C. L. WOLF AND S. LEFEVERE

Success in restoration and recovery of large carnivores requires public lands managers to address ongoing and new challenges for their conservation. In the Greater Yellowstone Ecosystem, conservation of expanding grizzly bear and extant black bear populations amidst increasing recreation and diverse use of public lands will require secure and careful management of human foods. Steps to minimize large carnivore-human conflicts are needed. We describe the rationale for food storage, recommend structures that are effective at securing human foods from bears, and critically review national forest efforts in northwest Wyoming during 2001-2003 to expand food storage provisions for improving public safety and conserving bear populations, both black and grizzly. We conclude with specific steps for implementing food storage provisions and improving the effectiveness of food storage and sanitation programs for bears and people based on experience with diverse interests and users of public lands in the Yellowstone region.

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# 3. American Marten Ecology on an Alpine Ski Area

THOMAS E. KUCERA[1]

Understanding the effects of forest management on wildlife has typically focused on timber harvest. The effects of another type of intensive management, associated with alpine ski areas, have received less attention. United States Forest Service planning documents for California discussed potential negative effects of habitat alteration, roads, and human activities on a number of "sensitive" species, including the American marten (*Martes americana*), and the possibility of restricting activities associated with alpine ski areas near marten den sites. Martens and their tracks are often seen on ski areas, but little in detail is known about marten use of these areas. Using radiotelemetry, I studied the ecology of American martens on the Mammoth Mountain Ski Area, Inyo National Forest, Mono County, California during 2002-2003. I compared results to those from a similar study of martens I conducted on adjacent, unmanaged forest. Martens on the ski area were overwhelmingly male, used human structures within the ski area boundaries and components of the native forest for rest sites, used human sources of food, and showed a tendency to leave the area in the spring. On the adjacent unmanaged forest, sex ratio of captures was nearly even, all forest types were used, and no human structures were present. Both study areas were in relatively high-elevation, open-canopy forest with little structure near the ground and few riparian areas. The presence of martens on a ski area, or other location, does not necessarily mean the presence of a healthy population.

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# 4. Spatial Analysis of Human Recreational Trail Use and Wildlife Movement in the Livingstone River Area, Southwestern Alberta

MICHAEL S. QUINN[1] AND DANAH DUKE[2]

The Livingstone River Area in southwestern Alberta is an ecologically significant area of public land that provides an important connection between adjacent protected areas. Most of the area is zoned for multiple use, which means the area is available for resource extraction and recreational activity. Recreational use in this area consists primarily of off-highway vehicle (OHV) use, random access camping and fly fishing. Recreational use is largely unmanaged and increasing. The proliferation of trails and campsites has become extensive in the past decade. Furthermore, much of this activity is concentrated along critical riparian movement corridors and in sensitive montane, subalpine and alpine environments. Human use and associated linear disturbance is recognized as among the most significant habitat fragmentation factor limiting sensitive wildlife (especially large carnivores) in the region. This paper reports our initial analysis of the spatial and temporal relationships between human use of trails, with a particular emphasis on OHV use, and wildlife movement. In particular, we report on a research design that utilized buried trail counters and remote cameras to monitor both humans and wildlife.

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# BLACK BEARS

*Moderator: Lisa Tryon*

## 1. Denning Ecology of American Black Bears in Western Virginia: Implications for Research and Management

ANDREW S. BRIDGES[1], JOSEPHINE A. FOX[1], COLLEEN OLFENBUTTEL[1] AND MICHAEL R. VAUGHAN[1]

American black bears (*Ursus americanus*) exhibit decreased activity levels and may enter a hibernation-like state during the winter. During this time, they may select, enter, and give birth in den structures. We collected denning data during 489 bear winters on 2 study areas in the Alleghany Mountains of western Virginia from 1995-2003. Den types included: 3 (0.6%) fall logs, 26 (5.2%) excavations, 31 (6.2%) did not or only temporarily denned, 64 (12.9%) rock cavities, 98 (20.0%) ground dens, 267 (53.6%) standing snags and trees. Den site selection varied by sex, age, and reproductive status. We checked 228 den structures 344 times to see if they were occupied in subsequent years. On 19 (5.5%) of these occasions, previously occupied dens were reused. In 2003, we used remote cameras to examine denning behavior and found bears were substantially more active in March and April than expected. Our results indicate that large hollow trees are an important component in black bear denning ecology in the Alleghany Mountains and are especially favored by parturient females. Additionally, we documented successful denning by 13 individual yearling cubs, indicating the common practice of annual cub survival estimation based on proportion of original litter found with the female in the den the following year likely results in underestimates. Finally, because our final conclusions differed substantially from those based on 3 and 6 years of data, relatively long-term studies may be necessary to acquire adequate sample sizes and follow individuals through different phases of their lives.

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# 2. Linking Resource Availability with Demography of a Black Bear Population in the Southern Appalachian Mountains

MELISSA J. REYNOLDS[1], LAURA L. BRONGO[1], MICHAEL S. MITCHELL[2] AND JAMES B. GRAND[2]

Hard mast and soft mast are important resources for black bears (*Ursus americanus*) in the Southern Appalachian Mountains, yet the degree to which each resource may limit a population is not fully known. We tested three competing hypotheses regarding the degree to which hard mast or soft mast limited a population of bears in the Pisgah Black Bear Sanctuary, North Carolina. We modeled annual distributions of hard and soft mast across the landscape from 1981-2002, as they changed due to clearcuts and succession. For hard mast, we included an index of annual production to account for variation in annual crops. We partitioned the distribution of soft mast to analyze if soft mast within clearcuts or soft mast across the landscape affected demography. We used capture-recapture data from 98 females captured during 1981-2002 and the temporal symmetry method to estimate survival, fertility, and population growth in program MARK. For each demographic parameter, we incorporated annual data on availability of hard and soft mast as covariates and used Akaike's Information Criterion to select the most parsimonious model. Our results supported best the hypothesis that soft mast limited the Pisgah bears. Models with covariates of soft mast ranked highest for all 3 demographic parameters. Soft mast across the landscape was more important than soft mast within only clearcuts, suggesting managers of bear populations should maintain both young and mature stands on a forested landscape. Hard mast was much less limiting perhaps because it was highly and consistently available from 1981-2002.

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# 3. Spatial and Temporal Distribution of Black Bear - Human Conflicts in Colorado*

SHARON BARUCH-MORDO[1], KENNETH WILSON[1] AND STEWART BRECK[2]

Anthropogenic changes due to development and encroachment into black bear (*Ursus americanus*) habitat can alter food sources by providing predictable and highly nutritional foods, such as garbage and bird feed. Colorado's human population has almost doubled since the 1970s, and the potential for bear-human conflicts, as well as the removal of problem bears under Colorado's "two-strikes rule" has also increased. Black bear-human conflicts rapidly increased in the 1970s, and data from 1995-2002 suggest variation in the pattern and number of conflicts. We used a Colorado Division of Wildlife database of Colorado black bear mortalities from 1979 to present that includes non-harvest-related mortalities, i.e., from road kills, accidental death, and engagement in human related conflicts that include nuisance, depredating and dangerous bears. Our goal is to understand the spatial and temporal distribution of bear-human conflicts in Colorado in relation to variables such as human density, annual precipitation, landscape metrics, and conflict type (e.g., agricultural, urban, and road kills). Using GIS, we mapped and compared conflict occurrences by type and spatial and temporal trends. In all years, areas of high conflicts were generally in the southwestern portion of Colorado, bounded on the east by I-25. Total number of conflicts more than doubled between the late 1990s and the early 2000s. In general, July and August comprised the majority of conflicts, up to 41% in August of 2001. We discuss possible causes for differences in the distribution of bear-human conflicts.

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*student competition

# 4. Investigating the Role of Social Learning in Problem Black Bears Using Genetic Relatedness Analyses

STEWART W. BRECK[1], CHRISTEN L. WILLIAMS[1], SEAN MATTHEWS[2], JON P. BECKMANN[3], CARL W. LACKEY[4] AND JOHN BEECHAM[5]

Black bears (*Ursus americanus*) at the interface of wildlands and human-altered landscapes can learn behaviors that help them exploit anthropogenic resources but cause them to be labeled problem bears. Learning in bears can occur via social mechanisms where an individual's learning is influenced by observation of another animal (e.g., parent-offspring link), or asocial mechanisms. Determining the importance of social learning via the parent-offspring link requires connecting known behaviors with the relatedness of individuals performing the behaviors. A high degree of relatedness among problem individuals could indicate a strong parent-offspring link in the transfer of problematic behaviors (i.e., social learning) and the possible development of a "society" of bears that progressively learn to utilize anthropogenic food sources. Conversely, a weak parent-offspring link may suggest that problem individuals learn from random processes which are not a vital component for the development of such behaviors. Understanding how bears learn has important management implications. In this study we evaluated genetic relatedness of black bears from two populations (Yosemite National Park and the Lake Tahoe region) using microsatellite DNA analyses. Bears were categorized as problem or non-problem bears based on observed behavior. We tested the null hypothesis that problem bears are no more related than random bears by comparing inbreeding coefficients (Fis), average pairwise relatedness, and the average number of 1st-order relatives in problem and non-problem bear groups. Levels of relatedness were also assessed between specific bear pairs.

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# CARNIVORES OUT OF PLACE

*Moderator: Susan George*

## 1. Effect of Golden Eagle Removal on Survivorship of Island Foxes

TIMOTHY J. COONAN[1], DAVID K. GARCELON[2] AND LINDA MUNSON[3]

Island fox (*Urocyon littoralis*) populations on the northern Channel Islands declined from 1995 to 2000 due to predation by golden eagles (*Aquila chrysaetos*). Using adiotelemetry we investigated survivorship and mortality causes for wild island foxes from 1998 to 1999 on San Miguel Island, during the last stage of the decline, and from 2000 to 2004 on Santa Cruz Island, during a period of golden eagle removal. Annual survivorship of island foxes on San Miguel Island was 11%. From 2001-2004 annual island fox survivorship on Santa Cruz Island increased from 60% to over 80%, the level previously determined by demographic modeling to be required for a stable or increasing population. In contrast to the increased survivorship of wild foxes, 7 of 12 foxes released from captivity on Santa Cruz Island in 2002-2003 were killed by golden eagles within weeks of release. On Santa Rosa Island, however, only 1 of 8 foxes released to the wild in 2003-2004 died of predation. Golden eagle predation accounted for 5 of 7 mortalities on San Miguel Island in 1998-1999 and 24 of 29 mortalities on Santa Cruz in 200-2004. Other causes of mortality included trauma, aspiration pneumonia, and septicemia due to infestation by the intestinal parasite Spirocerca. The overwhelming importance of eagle predation as a mortality factor for wild foxes, and the impacts of predation on released captive foxes, suggest that removal of golden eagles would result in increased survivorship of wild island foxes, and would render release from captivity a more effective recovery action.

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# 2. The Impact of Introduced Red Foxes on Australian Mammals in Jervis Bay, Australia

PAUL D. MEEK[1] AND NICK DEXTER[2]

The red fox (*Vulpes vulpes*) was introduced to Australia in 1871 as sporting quarry by English settlers. During the past 133 years the fox has spread across much of Australia and the impacts of this introduced carnivore on native fauna has been calamitous for small- to medium-sized mammals. However, this impact has remained largely unquantified. In 1995 a fox control program was implemented on Beecroft Peninsula using mound baiting and 1080 poison. Foxes were radio collared to measure the success or failure of the baiting program and mammal surveys were carried out to measure response of native species to fox control. Baiting occurs throughout the year and the program was expanded to nearby Bherwerre Peninsula (Booderee National Park). We have recorded a significant change in abundance to native mammals post-control. The long nosed bandicoot (*Perameles nasuta*) has increased from absent in 1995 to a 15% trap success rate in 2000. The bush rat (Rattus fuscipes) increased from zero to a trap success rate of 4.83%. The common ring-tailed possum (*Pseudocheiras peregrinus*) increased from 0.7 animals/100m of spotlighting to 1.8 animals/100m. We compared mammal community structure between sites and there was a significant difference between locations with more native mammals being recorded in the baited sites.

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# 3. Adaptive Experimental Management of the Introduced Red Fox to Protect Biodiversity

ALAN J. ROBLEY[1]

Parks Victoria (PV) currently invests considerable amounts of operating funding and time in order to control foxes on many of its reserves. Most of this control work is based on either deployment of buried 1080 baits, spotlight shooting, or a combination of both. The intensity with which these activities are carried out varies within and between reserves according to the perceived level of threat posed by foxes, the accessibility of the terrain, and the resources available for fox control. In a broad sense, the different intensities with which PV controls foxes at various locations can be thought of as representing a range of fox control strategies. Currently, PV has no process that allows it to formally assess the performances of these strategies in terms of their effect on the density of foxes or their prey. As such, the relative cost-effectiveness of PV's fox control strategies remains unknown. If PV can systematically relate the conservation benefits achieved through fox control to the intensity (and hence cost) of the strategies it employs, it will be able to address a number of key questions: 1) How do the costs and benefits of fox control vary with different spatial and temporal intensities of application? 2) What are the key environmental factors that affect the efficiency of fox control in different environments?

While these questions are obviously critical to PV's capacity to resource and target fox control efficiently, they will also be critical to the organization's longer-term capacity to contrast the benefits of investment in fox control with investment in other conservation activities.

Adaptive experimental management (AEM) offers the opportunity to systematically link the benefits and costs to different intensities of fox control. This paper documents the process of establishing an AEM program, outlines some issues we encountered in the first two years of its implementation.

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# 4. Competition in an Alien World: Translocated Mustelids in New Zealand

ROBBIE A. MCDONALD[1]

Guilds of ecologically and morphologically similar carnivores are a common phenomenon in their native continental ranges. However, very few of these assemblages have been translocated to new environments. In New Zealand, three species of small carnivore (ferrets, *Mustela furo;* stoats, *M. erminea;* and weasels, *M.nivalis*) were introduced in the 19th century. They have mostly thrived since and have successfully adapted to the alien environment of New Zealand. But how have they adapted to the presence of some of their competitors from the old world and the absence of others? Using a range of morphological and dietary measures I have compared competition among these three mustelids in their native and introduced ranges. I will report on my findings and the implications for our understanding of competition and evolution among carnivore guilds as well as commenting on the implications of competition for the conservation of native biodiversity in New Zealand.

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# INNOVATIVE FUNDING APPROACHES

*Moderator: Nina Fascione*

## 1. Finding Funding for Carnivore Conservation

**MARTHA SCHUMACHER[1], JEFFREY A. FLOCKEN[2], JULIE SCARDINA[3] AND JON CLARK[4]**

While there is no lack of threats to the continuing existence of carnivore species, there is always a pressing need for more funding to support efforts on their behalf. Vital conservation work cannot happen without adequate resources behind it. This panel session was created to help carnivore conservationists from both big and small organizations with the all-important and never-ending search for funding to support their conservation work. The panelists will address the following topics: 1) Creating the right development plan for your organization; 2) Finding government funding opportunities; 3) Creative partnering with the private sector, and 4) Building successful relationships with foundations.

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# 2. Farm Bill Programs: A Tool For Carnivore Conservation

RANDALL GRAY[1]

Seventy percent of the land base in the United States is privately owned and is an important consideration in the conservation of biological diversity. The farm bills have historically been focused on commodity support programs. However, since 1985 Congress has included increasingly larger and diverse conservation programs. A variety of programs such as the Conservation Reserve Program, Wetlands Reserve Program, Wildlife Habitat Incentive Program, and Grasslands Reserve Program have direct impacts upon both the quantity and quality of habitat form many species of carnivores including ocelots, otters, Louisiana black bears, wolves, and grizzly bears.

The diversity of conservation programs authorized by farm bills every five years are important tools in conservation. The suite of programs includes easements, habitat restoration, and specific practices benefiting both rare and declining habitats as well as individual species.

This presentation will provide an overview of the farm bill, discuss specific programs and their existing application for carnivore conservation, and discuss how the conservation community can be come more effective in applying these programs to address the conservation and protection of carnivore habitat.

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# 3. Carnivore Conservation Trust: A Model for Joint Private-Government Funding to Conserve and Manage Carnivores in North America

TIMMOTHY KAMINSKI[1], WAYNE D. OWENS[2] AND JAMES F. GORE[3]

Support for restoring and conserving carnivores within wildland areas of Canada, the U.S., and Mexico is significant and many citizens value carnivores as integral parts of ecosystems. Despite this support, the cost of recovery efforts and management of carnivores is increasingly difficult for federal, provincial and state wildlife agencies, and discretionary funds for wildlife including imperiled species have declined. Firearm sales proceeds are allocated for traditional big game management and research on harvestable populations; their use for non-game wildlife, including protected carnivores, has met resistance from wildlife officials and hunting constituencies in states and provinces where large wildland enclaves for managing wide-ranging and rare carnivores remain intact.

For carnivore conservation to succeed, we believe funding must be consistent and comprehensive in scope, address practical problems and solutions that sustain and conserve both humans and carnivores, be capable of shaping and improving management policies over time, and be equitable to diverse community interests. To enjoin public support with federal, provincial and state efforts for carnivore research, management and public education, we propose a joint private-government stamp for meeting carnivore conservation costs. We suggest this effort be modeled similar to the conservation program for waterfowl in Canada and the U.S. (e.g. North American Waterfowl Management Program) and be international in scope. We use geographically separate wolf conservation efforts across the United States, Canada and Mexico to elucidate how funds from a Carnivore Trust and Conservation Stamp could be generated from joint private-public investments and applied to carnivore conservation and management in North America.

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# PREDATOR - PREY DYNAMICS

*Moderator: Andrea Laliberte*

## 1. Modeling Wolf-Moose Ecosystems Using Cellular Automata

GEORGE D. CATALANO[1]

A recent advance in computational methods, the cellular automata, has resulted in a new approach to modeling predator-prey ecosystems. A cellular automata approach provides a simple, closed form mathematical model for highly complicated systems that are typically found in biology and ecology as well as in many other research areas. A simple cellular automata model consists of a lattice of sites with prescribed discrete values. The simplest values are 0 or 1 but any single discrete value or array of information (i.e. data) can be used as well. The value at each site then evolves deterministically with time according to a set of prescribed rules. Highly non-linear interactions such as characterize predator-prey ecosystems can be prescribed depending upon the construction of the rules.

Previously, a cellular automata approach reported by Gaylord and Nishidate has been used to model a grazing herd-pasture ecosystem, that is, with the predator capable of movement while the prey remains fixed. The present work extends the work to a moving predator and moving prey ecosystem. A specific predator-prey ecosystem is chosen, the wolf-moose system, in order to prescribe rules that model real interactions as noted by David Mech. Mech has described a typical wolf-moose interaction as including the following steps:(1) wolf senses moose and approaches (the stalk); (2) wolf and moose sense each other (the encounter); (3) wolf charges (the rush); and (4) moose runs (the chase).

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# 2. Elk Harvest and Wolf Presence In Idaho: Is There a Link?

JAMES CHRISTOPHER HANEY[1] AND KEITH LAWRENCE[2]

Recruitment of elk (*Cervus elaphus*) has declined in many areas of the western United States. In Idaho, annual elk harvest has fallen from a 50-year peak achieved just prior to reintroduction of gray wolf (*Canis lupus*). We searched for linkages between Idaho elk harvest declines and wolf population or distribution. Elk management units in Idaho that were 'below objective' for cows and adult bulls experienced significantly greater declines than units ëwithin objective' (~60% vs. 47-48). No difference in harvest reduction was observed between units with and without wolves (pooled $t = 1.493$, df = 53, $P = 0.141$). Step-wise regression failed to select wolf population size in modeling annual elk harvest; days hunted was selected, but with marginal significance ($r^2=0.439$, N = 7 years, $P = 0.105$). In the Clearwater Basin, where some of Idaho's most important harvests occurred historically, elk population decline was no greater than outside the Basin (pooled $t = 1.153$, df = 53, $P = 0.254$). We also found no evidence the harvest units in the Clearwater Basin were any more likely to have known or suspected wolves than elsewhere (likelihood ratio chi-square = 0.11, $P = 0.741$). Wolf presence was not associated with whether harvest objectives were below or within objective for a primary prey class (cow elk) taken by this predator (likelihood ratio chi-square = 1.28, $P = 0.258$). Examined at these spatial scales, then, neither wolf presence nor population size could be linked to statewide declines in elk harvest.

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# 3. Wolf-Elk Interactions on State Managed Feed Grounds and Adjacent National Forests in Wyoming

MIKE JIMENEZ[1] AND JOHN STEPHENSON[2]

We monitored wolves (*Canis lupus*) in winter from 2000 through 2003 to determine the distribution of wolf packs, describe prey selection of wolves, and document the behavioral response of elk (*Cervus elaphus*) to the presence of wolves on 3 elk feed grounds and adjacent national forest in Wyoming. We used radio telemetry to locate wolves and estimate home ranges. We back-tracked wolves to locate carcass remains of elk killed or scavenged by wolves. Radio collared elk were followed to describe how elk responded to wolves hunting on feed grounds. We located 152 kills made by wolves on all 3 feed grounds and the adjacent national forest. Forty-nine percent of the elk killed were cows, 4% bulls, and 47% calves. The mean age of adult elk killed was 9.5 years and the oldest elk killed was 23 years old. Mean consumption of elk carcasses by wolves was 83%. In 2001, calf/cow ratios dropped from a 10-year average of 27.6 calves/100 cows to 17.5 calves/100 cows. Calf/cow ratios increased in 2002 to 21.8 calves/100 cows. During winter 2002, 3,583 elk were counted in the Gros Ventre, compared to a 10-year average of 3,485 elk. Elk responded to wolves hunting on feed grounds by: 1) remaining on the feed grounds even when wolves killed elk; 2) leaving the area but returning within days; and 3) leaving the feed ground where wolves killed elk and gathering in larger herds on adjacent feed grounds absent of wolves. Displaced elk gathering on private property and elk crowding on specific feed grounds remains very controversial.

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[2]U.S. Forest Service, Bridger-Teton National Forest, Jackson, WY

# 4. Evaluating the Effects of Mexican Wolf Recovery on Elk Populations in New Mexico

STEPHEN G. KOHLMANN[1], CHUCK L. HAYES[1] AND NICK W. SMITH[2]

The recent and ongoing efforts to restore a viable population of the Mexican wolf (*Canis lupus baileyi*) into the mountains of southwestern New Mexico and southeastern Arizona created a new level of biological and socio-political complexity in managing wildlife resources. In simple trophic systems, consisting of only 1-2 predator and prey species, wolves can have a profound "top-down" controlling effect on ungulates. If ungulate populations are decreased by wolf predation, human recreation opportunities and harvest of ungulates may also have to be limited. Natural resource managers therefore require reliable information on how Mexican wolves and ungulates (primarily elk) interact. We examined the potential consequences of Mexican wolf restoration on elk populations in the Gila Mountains of New Mexico through a simulation model. Our model was based on existing data on wolf consumption and kill rates, population estimates of wolves and elk, and elk population dynamics. We evaluate different management strategies of elk regarding the viability of wolf restoration and human recreational harvest of elk. Our data suggest that a viable population of Mexican wolves may be compatible with elk populations managed for valuable recreational opportunities.

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[2]New Mexico Department of Game and Fish, P.O. Box 101, Quemado, NM 87829

# 5. Relative Contributions of Prey Physical Condition and Habitat Structure to Predation by Cougars and Wolves in Southwest Montana

TODD C. ATWOOD[1], ERIC M. GESE[1] AND KYRAN E. KUNKEL[2]

Vulnerability to predation resulting from direct or indirect effects of physical condition is allegedly a widespread phenomenon in predator-prey systems, yet there is a paucity of empirical support for the putative linkage between predator detection and avoidance behaviors and relative or absolute body condition. We examined patterns of prey selection by sympatric cougars (*Puma concolor*) and wolves (*Canis lupus*) to determine (i) if prey killed by wolves were in poorer absolute physical condition relative to prey killed by cougars; and (ii) if declining relative physical condition resulted in prey becoming risk-insensitive, thus making them more vulnerable to predation. Additionally, we assessed the role of vegetative structure in facilitating predation. Since 2003, we have documented prey characteristics and kill site attributes in the northern Madison range of southwest Montana. Mule deer (*Odocoileus hemionus*) were the primary prey for cougars, whereas elk (*Cervus elaphus*) were the primary prey for wolves. Wolves selected prey in relatively poor absolute physical condition compared to prey selected by cougars. However, declining relative condition in mule deer may have contributed to vulnerability to predation by cougars. Wolf kills occurred in habitat that was more reflective of the study area than cougar kills. These disparities suggest patterns in species-specific hunting behavior and prey selection differ considerably, and that prey are likely to forage in a risk-prone manner as physical condition declines.

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# 6. Cascading Effects of Subsidized Mountain Lion Populations in the Chihuahuan Desert

ERIC M. ROMIGER[1], RICK S. WINSLOW[1], ELISE J. GOLDSTEIN[1], DARREL L. WEYBRIGHT[1] AND WILLIAM C. DUNN[1]

The primary proximate cause of mortality in four recently extinct or nearly extinct desert bighorn sheep (*Ovis canadensis mexicana*) populations in New Mexico has been mountain lion (*Puma concolor*) predation. This has occurred in habitats with native ungulate densities hypothesized to be insufficient to maintain resident mountain lion populations. Mountain lions in the Chihuahuan desert ecosystem are a subsidized predator, with domestic livestock the principal subsidy. The high proportion of cattle in the diets of mountain lions in Arizona (Cunningham et al. 1999) is the basis for this hypothesis. We hypothesize that the ability to prey switch from native ungulate prey to domestic livestock or exotic wild ungulates results in an artificially high density of mountain lions. The potential cascading effects of a subsidized predator include population level impacts on low-density prey and the resulting effects of their rarity or extinction. Mule deer (*Odocoileus hemionus*) populations have declined drastically in the Chihuahuan desert during the last 30-50 years and mountain lion predation has become an additive mortality factor. Porcupine (Erethizon dorsatum), were common less than 30 years ago but appear to have been nearly extirpated from southwestern New Mexico. The near extinction of porcupines by mountain lions in a Nevada mountain range suggests that this may have occurred in southwestern New Mexico. Numbers of mountain lions harvested, in an effort to protect state endangered desert bighorn sheep, suggest that sport harvest in the Chihuahuan desert is an ineffective method for reducing subsidized mountain lion populations.

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# URBAN CARNIVORES

*Moderator: Jenny Neeley*

## 1. Death and Disease in the City: Disease Dynamics Among Urban Mesocarnivores

STANLEY D. GEHRT[1]

Urbanization can dramatically affect the population dynamics of mesocarnivores, which may also affect the dynamics of disease. During long term studies of raccoons (Procyon lotor), striped skunks (*Mephitis mephitis*), and coyotes (*Canis latrans*) in an intensively-urbanized landscape, I monitored the relative importance of select pathogens through radiotelemetry, serology, and necropsy. I estimated survival and cause-specific mortality for radiocollared skunks (n = 78), raccoons (n = 90), and coyotes (n = 96) in the Chicago, Illinois area during 1998-2003. Among mortality factors, disease was most important for skunks (38%), and less so for raccoons (19%) and coyotes (7%). Sero-positive rates for canine distemper were high (> 80%) for all species in every year, as were rates for canine parvovirus for skunks (82%) and coyotes (99%). Prevalence of leptospires was also similar across species. Necropsies of coyotes revealed normal parasite loads except possibly heartworm (36%), but parasite loads were important for skunks. The high sero-positive rates for canine distemper across species suggest the virus is common among Chicago carnivores, and there is a possibility of interspecific transmission. Surprisingly, disease from highly infectious pathogens is relatively unimportant for those species occurring at high urban densities, and may represent another adaptation amenable to urban landscapes.

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# 2. The Ecology of Eastern Coyotes on Urbanized Cape Cod

JONATHAN G. WAY[1]

We studied home range size, spatial arrangements, territoriality, and sociality of 23 radio-transmitted eastern coyotes (*Canis latrans* var.) inhabiting an urbanized area (Cape Cod, Massachusetts) between June 1998 and May 2002. Home range sizes were variable depending on the method used. Average home range size for breeding adult coyotes, using the 95% minimum convex polygon vertex edited method, was 29.8 ± 5.3 $km^2$. Resident coyote groups showed limited overlap in home ranges. Coyote social groups (or packs) consisted of 3-4 members. Resident coyote numbers on the study area were estimated at 0.08-0.15 coyotes/$km^2$. Coyotes were essentially nocturnal except for breeding females, which showed no temporal patterns of activity during April - June. Twenty four-hour movements of coyotes ranged up to 31.89 linear km and averaged 20.81 ± 7.91 (SD) km with 3-14 radio-fixes during each monitoring period. Collaborative partnerships between local area high schools and the coyote research team will also be discussed.

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# 3. Influence of Urbanization on Bobcat and Coyote Diets in Southern California

CATHERINE M. SCHOONMAKER[1], SETH P.D. RILEY[1], KIM A. ASMUS[1], REGAN N. SCHUTTE[1], LENA S. LEE[1], CASSITY BROMLEY[1], JEFFREY A. SIKICH[1] AND RAYMOND SAUVAJOT[1]

Carnivores can be particularly susceptible to urban habitat fragmentation because of their large spatial requirements. However, the effects of urbanization can also provide enhanced food resources for some species. From 1996-2004, we have been studying the impacts of urbanization on the ecology and behavior of bobcats and coyotes in a fragmented landscape in southern California. To better understand how resource use is affected by fragmentation, we collected bobcat (*Lynx rufus*) and coyote (*Canis latrans*) scat in small fragments, large fragments, and core areas from May 2001 to July 2003. Cottontail rabbits dominated the diet of bobcats in both small and large fragments, where they occurred in 61% and 67% of scats, while in contiguous habitat rabbits were present in 36% and woodrats in 73% of scats. In contrast, the coyote diet was dominated by fruit (69%) in small fragments and rabbits were present in only 17% of scats. Fruit was still a common coyote food item in large fragments (40%) and core habitat areas (36%), but rabbits became more important than in small fragments. For both species, rabbits were always the most common animal prey in habitat fragments. A concurrent study of the relative abundance of rabbits indicates that they are extremely abundant in fragmented areas. Rabbits may be a source of increased food availability for carnivores, and especially for bobcats, in urban areas, while ornamental fruit may be an important resource for urban coyotes. Other human-related food items such as trash and domestic cats were rarely found in coyote diets, even in small fragments.

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# 4. Social Structure, Genetic Relatedness and Reproduction in Urban Southern California Bobcats

CASSITY BROMLEY[1], SETH P.D. RILEY[1], JEFFREY A. SIKICH[1], CATHERINE M. SCHOONMAKER[1], JOHN POLLINGER[2], RAYMOND SAUVAJOT[1] AND ERIC C. YORK[1]

Habitat fragmentation and resource availability can affect population density and social structure in wildlife. Urbanization destroys and fragments habitat, but may also provide increased resources for animals able to exploit them. We address home range overlap and genetic relatedness of female bobcats (*Lynx rufus*) in a high density population living in a fragmented urban environment. It is often assumed that female bobcats maintain exclusive territories, and especially exclusive core areas. We found significant female/female core area overlap, even when both females have kittens. These overlapping female pairs are closely related (i.e. mother-daughter or siblings). We have also observed dispersal events in which young females establish home ranges that overlap with or border on those of their mother. In 1997-1998 and 2001-2004, we also assessed birth rate in fragmented and contiguous habitat over 67 female bobcat-years. Birth rate has been higher in fragmented habitat than in contiguous habitat. We are now investigating the survival rate of urban kittens using implanted transmitters in order to more fully address reproductive success.

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[2]University of California, Department of Organismic Biology, Ecology and Evolution, Los Angeles, CA

# 5. Ringtailed-Cat Home Range Within Mexico City

GABRIELA CASTELLANOS-MORALES[1], NATALIA GARCIA-PENA[1] AND RURIK LIST[1]

The El Pedregal de San Angel Ecological Reserve is the last relict of a *malpais* (volcanic rock habitat) that originated with the eruption of the Xitle volcano. This 147-ha reserve is located within one of the largest cities of the world, Mexico City, and harbors a population of ring-tailed cat (*Bassariscus astutus*). Despite its wide distribution and its ability to adapt to human influence, little has been published on this species. Eleven ringtails (9 males and 2 females) were captured in two periods, from April 29, 2002 to July 15, 2003. Capture success was 1 per 62.6 and 1 per 23.7 trap nights for the first and second periods respectively. Bait used is a factor affecting capture success. Mean weight of captured individuals was 1647.2 ± 208.1 grams, heavier than the reported weight. Ten of eleven ringtails were radio-collared but due to reduced collar range and radio-interference from the City, only four males (three adults and one juvenile) produced location fixes (35-71 fixes) to estimate home range. Home-range analysis was conducted with the Animal Movement Analysis Arc View Extension. 95% Minimum Convex Polygon (X = 9.28 ± 0.7 ha for adults and 3 ha for the juvenile) and 95% Fixed Kernel (X = 10.32 ± 0.9 ha for adults and 3.2 ha for the juvenile) were calculated.

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# 6. Spatial Use of a Suburban Carnivore: The Gray Fox in Mexico City

NATALIA GARCIA-PENA[1], GABRIELA CASTELLANOS-MORALES[1] AND RURIK LIST[1]

The gray fox (*Urocyon cinereoargenteus)* is the most abundant and wide-spread carnivore in Mexico and is common near human constructions, but there are no studies of urban populations of this or any other carnivore in Mexico. A gray fox population exists in the 147-ha El Pedregal de San Angel Ecological Reserve, within Mexico City's Campus of the National University of Mexico. We captured and radio-collared six gray foxes (3 males and 3 females) in the reserve, to determine their home ranges and habitat use. Capture success changed from 1 per 104.3 trap-nights in the first capture period, to 1 per 27.1 trap-nights in the second period, probably as a result of bait used. Five of the foxes were radio-tracked using two null-peak system antennas, from 21:30 to 05:30 hrs for 4-10 months, producing 60 to 160 fixes per individual. Location data was analyzed with the Animal Movement Analysis Arc View Extension, home range estimated with 95% MCP was 79.85 ha for males and 37 ha for females, and 35.15 ha for males and 26.14 ha for females estimated with 95% fixed kernel estimator. Foxes are distributed throughout the study area but they use portions of the campus outside the Reserve, and close to buildings and other university infrastructure; however, they need the Reserve for daytime cover, rest and breeding, therefore is important to limit the expansion of the University infrastructure over the buffer zone of the reserve.

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# 7. Ringtail Scent-Marking With Feces

ISABEL BARJA NÚÑEZ[1] AND RURIK LIST[2]

Scent-marking is the main source for the spread of information in carnivores, and is particularly important for those with nocturnal activity, like the ringtail (*Bassariscus astutus*). However, little is known about the olfactory marking behavior of the species, being just occasionally mentioned in a few general works of olfactory communication. The aim of the study was to determine if ringtail feces function as scent marks, by characterizing feces deposition sites. The study was conducted in the 1.46 km$^2$ Pedregal de San Angel Ecological Reserve of the National University of Mexico, which is crossed by several roads of varying sizes, and is completely surrounded by the City. The reserve is the last stronghold of a native habitat that grows on volcanic rock, which once was widespread in the Valley of Mexico. Our results show that ringtails defecate mainly at latrine sites, which had a variable number of feces, and also that the latrines were frequently visited to re-mark. Feces distribution (single feces and latrines) was not random, but there was a selection of substrates and zones that enhanced the efficacy of feces as scent-marks. Furthermore, latrines were mainly located in elevated sites and in the shoulders of roads in the zones without road intersections.

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# TUESDAY EVENING EVENTS

## 5:30 P.M. TO 7:00 P.M.
## (LA FONDA MEZZANINE, IN FRONT OF LUMPKINS BALLROOM)

**Booksigning and Silent Auction**

Please join us for a silent auction to benefit Defenders of Wildlife's Bailey Wildlife Foundation Proactive Carnivore Conservation Fund. This fund supports proactive measures to reduce the likelihood of conflict between livestock or property and carnivores, including wolves and bears. Defenders gratefully acknowledges the following silent auction contributors:

3Triangle Forge
AK Adventures
Alaska Wildlife Alliance
Terri Hall Bumgardner
Betsy Duwe
Conservation in Practice
Enhydra lutris Nature Photography
David Baron
Gary Wockner
Gerald Peters Gallery
Guy D'Allessandro
Helen Thayer
High Country News
Images of Nature
JoJo Collection
Marine Wildlife Foundation
Michele LaFontaine
NatureGirl Art
Out of Africa
Patagonia
Pat Morris
Price Dewey Galleries
Red Wolf Coalition
Rob Barber-Delach
Robert Bateman
Robert and Harriet Jakovina
Sandy Barnett
Santa Barbara Zoo
Scott Barry
Steve Kendrot
Steve Oliver
Susan Wallace Barnes
Ten Thousand Waves
The Bark Stops Here
The Cougar Fund

Wayfarer Photography
Wilderness Inspirations
Wildlife Along the Rockies
Wolf Education & Research Center
Paul Zarzyski

The evening will also feature a booksigning including well-known wildlife authors, including Nina Fascione, Bobbie Holaday, Penelope Grenoble O'Malley, Dick Russell and more! A cash bar will be available and light refreshments will be served. The event is free for registered participants.

## 7:00 P.M. TO 10:00 P.M. (LUMPKINS BALLROOM)

Join us for a banquet dinner in the ballroom, followed by a presentation by Nez Perce conservationist and storyteller Levi Holt. Cost $40.

## 9:00 P.M. TO 10:30 P.M.

Winners of the Silent Auction will be posted at the Mezzanine, and conference staff will be available to process the winning purchases. Purchases can also be picked up Wednesday at the conference registration desk.

# WOLF RECOVERY

*Moderator: Gina Schrader*

## 1. Restoration of the Gray Wolf in the Northwestern United States

EDWARD E. BANGS[1], JOSEPH A. FONTAINE[1], MICHAEL D. JIMENEZ[1], CARTER C. NIEMEYER[2], DOUGLAS W. SMITH[3], CURT M. MACK[4] AND VAL ASHER[5]

Gray wolf (*Canis lupus*) populations were eliminated from the western United States by 1930. Naturally dispersing wolves from Canada first denned in Montana in 1986. In 1995 and 1996 wolves from western Canada were reintroduced to central Idaho and Yellowstone National Park, Wyoming. By December 2003, 761 wolves were being managed in the northern Rocky Mountains under the U.S. Endangered Species Act. Wolf restoration has proceeded more quickly, with more benefits (public viewing and restoration of ecological processes), and fewer problems (livestock and pets depredations) than predicted. However, between 1987 and December 2002, at least 301 cattle, 804 sheep, 63 dogs, 10 goats, 9 llamas, and a horse were killed by wolves and over $308,000 was paid from a private damage compensation fund. The U.S. Fish and Wildlife Service and cooperators relocated 117 wolves and killed 207 to reduce the rate of conflict. Management also included non-lethal tools such harassment, barriers, guard animals, altering wolf activity patterns, livestock management, and practical research. Livestock losses by wolves remain rare compared to other causes of livestock death but are inordinately controversial. Because over 85% of adult wolf mortality is human-caused, the interagency recovery program focuses its efforts on addressing the concerns of people who live near wolves to increase tolerance of non-depredating wolves. The wolf population achieved its numerical, distribution and temporal recovery goal and is biologically recovered. Wolves were reclassified from endangered to threatened status in April 2003 and three distinct population segments were created. In early 2004 proposed "10j nonessential experimental" rules for Montana, Idaho, and Wyoming were published. The proposed changes were made to recognize wolf population recovery, increase options for problem wolf management, and encourage state leadership in states like Montana and Idaho that developed biologically and legally sound state wolf management plans. This wolf population will be proposed to be removed from the list of endangered species when Wyoming finalizes a state wolf management plan that regulates human-caused mortality so the wolf population is not again jeopardized with extinction.

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[2]U.S. Fish & Wildlife Service, 1387 Vinnel Way, Rm 368, Boise, ID 83709

[3]P.O. Box 168, Yellowstone National Park, WY 82190

[4]Nez Perce Tribe, 1000 Mission, McCall, Idaho 83638

[5]Turner Endangered Species Fund, 1123 Research Drive, Bozeman, Montana 59718

# 2. Preliminary Results: Status of Red Wolves in Northeast North Carolina After Five Years of Adaptive Management and 17 Years of Experimental Restoration

BUD FAZIO[1]

We report preliminary results showing good progress in managing the world's only wild red wolf (*Canis rufus*) population. Red wolves were restored to northeastern North Carolina in 1987 when coyotes (*Canis latrans*) were not present on the Alligator River NWR. In 1999, an adaptive management plan was developed to address the threat of dilution of the red wolf gene pool caused by interbreeding with eastern coyotes entering the red wolf experimental population area. The adaptive management plan uses sterilized animals (hybrids or coyotes) as "territorial space holders" to buffer against coyote gene introgression and help build the red wolf population. The adaptive plan also uses geographic zones of gradated management intensity to mitigate the impact of coyote/red wolf interactions. Active trapping, radio collars to support land based and aerial telemetry, and genetic analysis of scat surveys are some of the tools used to assess the genomic integrity of the zones from 1999 to present. Intensive data management using advanced GIS technology also allows adaptive adjustments to annual management. Due to success of the red wolf adaptive management plan, the red wolf population is expanding, while the number of coyote/wolf hybrids is effectively reduced.

[1]U.S. Fish and Wildlife Service, Red Wolf Recovery Program, Alligator River NWR, P.O. Box 1969, Manteo, NC 27954, Buddy_Fazio@fws.gov

# 3. Crafting Effective Recovery Strategies for Wolves in the U.S. Using Dynamic Models

CARLOS CARROLL[1]

Defining recovery goals for species such as the wolf (*Canis lupus*) that have high area requirements for viable populations and yet whose protection potentially conflicts with other land uses has stimulated contentious debate over what constitutes recovery. The Endangered Species Act and conservation science suggest that our goal should be recovery over a significant portion of the historic range. Although wolf restoration has made great progress in the last decade, wolves currently occupy less than 5% of their historic range in the U.S. In order to secure long-term viability of restored wolf populations, we must address recovery issues over a larger spatial scale and longer temporal scale. I used a dynamic population model (PATCH), which incorporates data on human population growth and development trends, to estimate the distribution of suitable wolf habitat throughout the U.S. and identify habitat trends that may compromise future wolf persistence. The results identify critical core areas that are the key to regional persistence, as well as interregional linkages that allow wolf populations to expand to occupy smaller and more isolated habitat patches. The PATCH results help forecast how populations might respond to alternative futures where current development trends either continue or are slowed or reversed through habitat restoration. Such a comprehensive habitat and viability assessment, by more rigorously defining what constitutes a significant portion of range, can help inform the development of federal recovery criteria, aid states as they begin to draft wolf management plans, and help local conservation groups place their work within a regional context.

[1]Klamath Center for Conservation Research, P.O. Box 104, Orleans, CA 95556, carlos@sisqtel.net

# 4. If We Plan It, Will They Come? Planning for Wolves in Oregon

AMAROQ E. WEISS[1]

In 1999, five decades after the last known wild wolf (*Canis lupus*) was extirpated from Oregon, wolves from the dispersing Idaho population began to appear in the state. In 2003, following extensive hearings, public meetings and legal briefings, Oregon announced that the state would develop a wolf management plan. In writing the plan, the Oregon Department of Fish and Wildlife (ODFW) has been assisted by a Wolf Advisory Committee representing diverse stakeholder interests, with expertise available from wolf specialists from the federal government, the Wisconsin Department of Natural Resources, and the Nez Perce Tribe. Aiming for completion of a draft plan for a public comment process in the fall of 2004, the state expects to adopt a plan by January 2005. Oregon state law is currently more protective of wolves than the current federal classification and the Oregon plan will address these differing levels of protection. The Oregon plan borrows from but mirrors none of the plans developed thus far by six other states, because Oregon does not yet have a reproducing population of packs with established territories. The plan may face hurdles in the state legislature. A frenzied introduction of anti-wolf legislation occurred in 2003, and discussions of potential legislative amendments to the state endangered species act during the 2005 legislative session are already underway. In short, the Oregon wolf management plan will only be as good as the intentions of the parties involved and the protections state law maintains to conserve the wolf.

[1]Defenders of Wildlife, PMB 510, 2305-C Ashland Street, Ashland, OR 97520, aweiss@defenders.org

# 5. Securing a Future for Gray Wolf Recovery in the Northeastern U.S.

PEGGY STRUHSACKER[1]

In a response to the improved conservation status for the gray wolf (*Canis lupus*), in April 2003 the U.S. Fish and Wildlife Service (FWS) published a reclassification rule that removed the species from the federal list of endangered and threatened wildlife (i.e. delisted) in all or parts of 16 southern and eastern states. Elsewhere the reclassification rule divided the lower 48 states into three distinct population segments (DPS). New York, Vermont, New Hampshire, and Maine, which had been previously listed as a separate DPS in the 2000 proposed wolf rule, are now part of the Eastern DPS. The implication of this rule is there will be no further federal gray wolf recovery efforts within the Eastern DPS.

Wolf recovery in the northeast requires federal oversight for the protection of the species. In the last ten years, wild wolves have dispersed into southern Quebec and Maine, but ended up dead, a result of lack of protection and education. While experts have concluded that there are serious limits to a natural recovery option, it nevertheless remains a possibility. A priority for National Wildlife Federation (NWF) is to restore a wolf population in the Northeast. NWF approaches the restoration through policy work, litigation and research. This paper will detail 1) the ongoing research to establish whether the gray wolf has re-colonized from Quebec; 2) policy work with other organizations, the New England Governors and Eastern Canadian Premiers conference and to facilitate the exchange of information and technical expertise through the Wild Species at Risk framework; 3) the use of market instruments; and 4) the protection of the Endangered Species Act.

[1]National Wildlife Federation, 58 State Street, Montpelier, VT 05602, struhsacker@nwf.org

# CARNIVORES AND HIGHWAYS

*Moderator: Trisha White*

## 1. North America's Most Critical Highways for Carnivore Conservation

WILLIAM C. RUEDIGER[1] AND JAMES J. CLAAR[1]

The authors will provide an overview of the twelve highways in North America that have the greatest impact on present and future carnivore conservation. The discussion will include: the criteria for these highways, where the highways are located, and why they are judged to have the greatest impact on carnivores. The identification of these highways provides agencies and conservation groups with a list of priorities that should receive immediate attention for restoration, including wildlife linkage analysis, wildlife crossings, research and funding. Broad-scale recommendations for corrective measures will also be presented. Providing a short list of highways that seriously impact carnivores will challenge others to assess these highways, as well as those highways not included, and begin a dialog on how to address habitat connectivity priorities for North America's carnivores.

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# 2. Carnivores, Roads and Habitat Permeability in the Canadian Rocky Mountains: A Community Level Study

SHELLEY M. ALEXANDER[1], PAUL C. PAQUET[2] AND NIGEL M. WATERS[1]

Roads are ecologically expensive: their traffic causes wildlife mortality, environmental contamination, and can disrupt ecological processes. There remains little research on the permeability of unmitigated roads for carnivores or communities. During winters 1997-2000, we examined whether varying highway traffic volume changed rates of movement (permeability) for 6 carnivore and 4 ungulate species in the Canadian Rocky Mountains. Frequency and location of crossings were recorded on 4 highways: the Trans-Canada Highway (14,000 AADT*) and 1A Highway (3,000 AADT) in Banff National Park, and the Highway 40 (5,000 AADT) and Smith-Dorrien Trail in Kananaskis Country (2,000 AADT). Permeability was measured using species movement rate (road crossings per km), corrected for habitat potential based on track density estimates from transects adjacent to roads. Spatial metrics that may augment species movement rates, including distance to vegetation, topographic features, and distance to linear disturbances were derived from a Geographic Information System (GIS). Using a Kruskal-Wallis H-test we found higher traffic volume significantly reduced habitat permeability for guilds and the community ($P < 0.05$). Our correlation analysis also confirmed that permeability decreased with traffic volume ($P < 0.01$), and was moderated by distance to cover, distance to rivers, and proximity to other roads. We found strong evidence that landscape permeability was significantly impaired for carnivores at moderate traffic volume, whereas ungulate and community permeability were not reduced until high and very-high traffic volume. We determined specific thresholds at which roads should be mitigated to restore or maintain habitat connectivity.

* Annual Average Daily Traffic

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# 3. A Coarse Monitoring Approach to Wildlife Distribution and Fragmentation Based on Human Highways

DAVID L. GAILLARD[1]

The current distribution and fragmentation of rare, wide-ranging forest carnivore populations in western North America is poorly monitored, and this is an obstacle to understanding the fragmentation problem and successfully restoring these species. A comprehensive approach to monitoring carnivore distribution and fragmentation is proposed, whereby the Rocky Mountain region is divided into wildlife units bounded by human highways, and these units are monitored over time for their occupancy of rare carnivores, specifically the fisher (*Martes pennanti*), grizzly bear (*Ursus arctos*), lynx (*Lynx canadensis*), wolf (*Canis lupus*), and wolverine (*Gulo gulo*). Some results of this approach based upon preliminary data are presented, which demonstrate that fragmentation is a significant problem across some portion of the range of each of these carnivore species. Some of the fragmentation problems evident from this analysis are already the subject of research and conservation work, but many are not. This methodology serves two goals. First, it can provide a reliable, inexpensive, and easily accessible database to monitor species distribution at the regional scale over time, which can be a useful surrogate for monitoring their conservation status. Second, it can serve as a simple and comprehensive approach to monitor wildlife fragmentation at the regional scale, and be a first step to identifying fragmentation problem areas and working to resolve them wherever they may pose an obstacle to species restoration.

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# 4. Innovative Partnerships that Address Highway Impacts to Wildlife Connectivity in the Northern Rockies

DEBORAH KMON-DAVIDSON[1] AND ELIZABETH A. ROBERTS[1]

The U.S. Northern Rocky Mountains are comprised of three large and sparsely populated states. They are also exceedingly highway-oriented places, with one of the highest rates of rural travel in the country. High volumes of traffic along transportation corridors can block, deflect, or delay daily, seasonal and lifetime wildlife movements, as well as result in habitat loss and direct mortality to the region's signature species such as the grizzly bear, elk and lynx. American Wildlands has used scientifically defensible methodologies to identify over 100 potential wildlife migration corridors between the Northern Rockies' core protected areas. U.S. Interstates or State Highways bisect the majority of these potential wildlife corridors.

American Wildlands has organized an innovative multi-disciplinary working group to improve wildlife movement and human safety in a potential wildlife corridor in Montana. This working group has representatives from federal, state and county agencies as well as land trusts, independent biologists, conservation groups, and university researchers and is working to reduce factors limiting wildlife movement across the landscape, improve highway safety, protect key parcels of private land and ensure that public lands are managed in a way that promotes habitat connectivity. The members have developed scientific studies, using GIS and field biology tools with the objectives of identifying the highway's impacts on wildlife. The findings from these scientific studies have been incorporated into private and public lands conservation efforts and highway mitigation initiatives. The group has successfully secured funding for mitigation projects that will improve wildlife movement and human safety along I-90.

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# KIT FOXES

*Moderator: Gary Roemer*

## 1. Effects of Habitat Attributes on Competition Between Endangered San Joaquin Kit Foxes and Coyotes*

JULIA L. NELSON[1,2], BRIAN L. CYPHER[1], CURTIS D. BJURLIN[1] AND SCOTT CREEL[2]

Coyotes (Canis latrans) are the primary predator of endangered San Joaquin kit foxes (Vulpes macrotis mutica). However, habitat relationships and the effects of land management practices on kit fox and coyote competitive interactions remain unknown. We monitored space use patterns, diet, prey abundance, and survival of kit foxes and coyotes at the Lokern Natural Area in central California from January 2003 through June 2004. Habitats at Lokern consist of saltbush shrublands and extensive burned areas devoid of shrubs. Over 55% of kit fox mortalities (n = 26) were the result of predation, most likely by coyotes. An additional 23% of kit fox mortalities also were likely the result of predation. Coyote home ranges primarily encompassed shrublands while kit fox home ranges encompassed both shrublands and burned areas. Nonetheless, we observed minimal overlap in space use between collared coyotes and kit foxes, especially during pup rearing and at kit fox den locations. However, kit foxes with home ranges that intersected shrublands may have lower survival rates. Leporids and nocturnal rodents were the primary items in coyote diets while nocturnal rodents were the primary items in kit fox diets. Both leporids and nocturnal rodents were more abundant in shrublands. Thus, predation risk and food availability both appear to strongly influence kit fox demographic and ecological patterns. Habitat manipulation could potentially be used to ameliorate competitive interactions between coyotes and kit foxes.

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# 2. Artificial Dens as a Conservation Tool for Endangered San Joaquin Kit Foxes

BRIAN L. CYPHER[1], CURTIS D. BJURLIN[1], JAMES D. MURDOCH[1] AND ALEXANDER D. BROWN[1]

The installation of artificial dens has been used as a common mitigation measure and occasional conservation tool for endangered San Joaquin kit foxes (*Vulpes macrotis mutica*). However, subsequent use of these dens by kit foxes is rarely evaluated and optimal den designs for foxes have not been identified. In 2001, we initiated an investigation to examine use of artificial dens by San Joaquin kit foxes. Our objectives were to determine (1) whether foxes would use the dens; (2) whether foxes exhibited a preference among den designs or materials; and (3) for what purpose(s) the foxes used the dens (e.g., escape, diurnal cover, pup-rearing). We also examined temperature and humidity in the dens relative to ambient conditions and relative to conditions in natural dens. Additionally, we examined the attenuation effects of dens on radio telemetry signals. Thirty-four artificial dens were installed comprising 6 different designs, 4 different tunnel materials, and 2 different chamber designs. Kit foxes used all 6 den designs tested, but exhibited more frequent use of subterranean chambered dens. Dens were used for escape cover, day time resting and avoidance of temperature extremes, and also for pup rearing. Conditions in artificial dens were significantly cooler and more humid compared to ambient conditions, particularly in summer, and were similar to conditions in natural dens. Also, radio signal attenuation was similar between artificial and natural dens. Thus, artificial dens are potentially effective tools for conserving endangered San Joaquin kit foxes.

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# 3. Mortality and Home Range of the Kit Fox

MAURICIO COTERA-CORREA[1] AND LAURA SCOTT-MORALES[1]

The kit fox (*Vulpes macrotis zinseri*) is associated with arid ecosystems of the American Southwest and Northern Mexico. In Mexico there are very few studies on this species, the most of them about their distribution range. Because of their threatened status we studied the mortality causes and home range of the kit fox in Galeana, Nuevo Leon, Mexico. During 18 months we studied 15 kit foxes from six families equipped with radiotransmitters. Ten (67%) foxes died in a period of 15 months: five were struck by vehicles, two died of indeterminate causes, one was shot, one was killed by coyote or dog, and one was not recovered. The home range was estimated for ten foxes using Ranges software. Adult foxes home range averaged 4.36 $km^2$, male home ranges (3.98 $km^2$) were almost 20% smaller than females home ranges (4.94 $km^2$), but this difference was not significant (Mann-Whitney $U = 6$, $P = 0.2$). The home range for one female young fox was calculated in 1.69 $km^2$ and 1.97 $km^2$ before and after the fox left the natal den. Because the study area is divided by a highway, it is not a surprise that the principal mortality factor was by vehicles. Illegal hunting could be an important issue, as kit foxes are sometimes mistaken for young coyotes. Our results showed that the home range size was the same, bigger or smaller than in other parts of the kit fox distribution range.

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# 4. An Assessment of Hair Trap Designs: Removing the Ambiguity of Non-Invasive DNA Sampling from Individuals

SAMANTHA BREMNER-HARRISON[1], BRIAN L. CYPHER[1], JAMES D. MURDOCH[1], STEPHEN W.R. HARRISON[1]

Carnivores in general are difficult to monitor using conventional methods, making an alternative to traditional methods desirable. Advances in molecular DNA profiling provide opportunities to collect increased amounts of information on populations of elusive carnivores, such as canids. Ease and expense of DNA analysis of non-invasive samples varies, with hair samples proving less expensive and producing better quality DNA than scat samples. Hair-traps provide an alternative non-invasive means of obtaining DNA samples, however, they present associated problems. First, current methods of hair collection often do not provide sufficient means to prevent contamination between individuals, rendering sample identification questionable. Multiple sampling within a trap severely limits data obtained, as it is not possible to produce accurate individual genotypes, thus limiting the overall ability to obtain useful population data. Secondly, behavioral studies of captive animals have demonstrated variation between animals in avoiding novel objects, thus, hair traps may only provide information on a sub-set of the population.

We designed and tested several variations of hair trapping mechanisms, with the aim of producing a trap that would eliminate the risk of multiple sampling, and be both cheap and easy to produce. Trials were conducted on both captive and wild populations of endangered San Joaquin kit fox (*Vulpes macrotis mutica*) to assess trap design, success rate of trap operation, exclusion of multiple animals, ease of use, and trap preference by foxes.

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# MEXICAN WOLF RECOVERY

*Moderator: Craig Miller*

## 1. Return of the Mexican Gray Wolf: Back to the Blue

**BOBBIE HOLADAY**[1]

Do you know what I was asked when I began my efforts to return the Mexican wolf (*Canis lupus baileyi*) to its historic habitat? "You've got to be out of your mind!" "They'll never return wolves to Arizona!" "The ranchers won't allow wolves in this state." "It will never happen!" "Why don't you just enjoy your retirement?" These outbursts greeted me when I announced that I was organizing Preserve Arizona's Wolves (P.A.WS.) to support the return of the Mexican wolf. Although many people expressed hope that wolves might someday roam the state's forests, no organized support existed in Arizona for the Mexican wolf's return. Many voices declared opposition to the wolf's return, but no citizens' voices in Arizona publicly supported returning wolves to their historic habitat. Enthusiastic citizens responded to my announced goal of bringing back the Mexican wolf, and they joined P.A.WS. But nothing prepared me for the firestorm that was going to erupt, pitting environmentalists against ranchers, making enemies of neighbors, and placing the national spotlight on what had been a quiet ranching community. By then I was well into the thick of things and had no intention of turning back. The road to Mexican wolf recovery was rough; sometimes it seemed insurmountable obstacles would never be overcome—but it did happen. Today ten packs, several lone wolves, and an undetermined number of pups make up the population of about seventy wolves that roam the forests of the Blue Range Wolf Recovery Area in the Apache and Gila National Forests.

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# 2. Rewilding the Southern Rockies

ROB EDWARD[1]

Over the past decade, citizens and scientists have collaborated to build a strong scientific case for repatriating wolves (*Canis lupus*) to the hunting grounds of their ancestors in the Southern Rockies. Rooted in the principles of conservation biology, the movement to restore wolves is now at a crossroads. State and federal plans now in development hold the potential to catalyze a reintroduction effort for the region, or to foment a statewide ballot initiative on the issue in Colorado. Ultimately, citizen participation in the process will determine the wild future of the Southern Rocky Mountains.

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# 3. Fate of the Mexican Wolf Teeters Between Science and Politics

MICHAEL J. ROBINSON[1]

In 2003, only three breeding pairs of Mexican gray wolves (*Canis lupus baileyi*) could be confirmed in the wild — though the EIS on reintroduction had projected ten breeding pairs by then. This demographic shortfall reflects three management provisions encapsulated in the 1998 Federal Register notice authorizing the reintroduction, which uniquely apply to Mexican wolves. These provisions contribute to mortality by requiring federal capture, translocation and/or killing of wolves under circumstances in which other endangered species (including wolves in the northern Rocky Mountains) are allowed to roam freely. In June 2001, four independent scientists led by Paul C. Paquet, Ph.D., recommended changing those provisions. Despite subsequent endorsement of such reforms by the New Mexico Game Commission (which had originally advocated the special provisions), the U.S. Fish and Wildlife Service has failed to amend the Federal Register. When the Paquet Report was released there were 27 radio collared and monitored Mexican wolves in the wild. In June 2004, despite the capture and outfitting with collars of nine wolves in the interim, that number has declined to fifteen — suggesting a possibly declining population (and one that will likely fall below the 68 wolves, including ones without collars, projected in the Environmental Impact Statement for December 31, 2004). Recovering the Mexican wolf will require substantially moderating the federal predator persecution that began in 1915 and never really ended for this highly endangered subspecies. Such a change should be rooted in consideration of the unique adaptation of the "lobo" to the arid landscapes in which it evolved.

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# 4. Potential Areas for Wolf Reintroduction in Mexico

MARCELA ARAIZA[1] AND RURIK LIST[1]

We identified sites for potential reintroduction of Mexican wolves (*Canis lupus baileyi)* in the Mexican states of Chihuahua, Coahuila and Sonora, through a landscape spatial analysis, using a Geographic Information System, digital cartography, and criteria which can be applied on a regional scale and can influence permanence and dispersal of wolves. The sites with greater potential for reintroduction are the northern part of the Sierra Madre Occidental between Sonora and Chihuahua, and Sierra del Tigre in Sonora; this area has no human settlements or major dirt roads. Next we assessed prey density and biomass (white-tailed deer) by count of pellet groups within these areas, and determined prevalence and distribution of canine parvovirus and distemper in coyote (*Canis latrans*), foxes (*Urocyon cinereoargenteus*) and domestic dogs (*Canis familiaris*). The prevalence of these diseases was positive, but should not be considered as impediment for reintroduction; however, preventive and control measures for these diseases are recommended. Prey biomass and density are in the lower limit reported to sustain wolves. Neither the extent of this area (6,000 km$^2$) nor prey density is enough to maintain a viable population of wolves in the long-term. With hunting control and the acceptance of reintroduction by local people in the adjacent areas, 15,892 km$^2$ without roads could be available for the wolves, and an even larger area if the wolves reintroduced in United States disperse to this area and vice versa.

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# 5. Mexican Gray Wolves: Challenges for the Captive Breeding Program in 2004

PATRICK C. VALENTINO[1] AND DANIEL D. MORIARTY[1]

Formidable challenges facing the Mexican Wolf Recovery Program include the release of captive raised wolves. This presentation will outline the current status of the Mexican gray wolf (*Canis lupus baileyi*) in captivity and challenges facing captive managers in raising a "wild wolf."

Listed in 1976 under the U. S. Endangered Species Act of 1973, the Mexican gray wolf is one of the rarest land mammals in the world. The ultimate goal of the Mexican Wolf Recovery Plan, signed in 1982, is the re-establishment of wild populations from captive-raised wolves. The captive population in the United States has been managed by the American Zoo and Aquarium Association's Mexican Wolf Species Survival Plan. Today about 285 Mexican wolves survive, and most are held at 45 captive facilities in the United States and Mexico. The others are free ranging in the Apache and Gila Forests of the Arizona - New Mexico border.

Mexican wolf recovery is at a critical crossroads. While more pups are being born in the wild, political boundaries have restricted "free" recovery of Mexican wolves. The number of wolves that can be released and the number that need to be managed or returned to captivity will greatly impact the focus of captive wolf managers. Mexican wolves are held in a variety of facilities. The diversity of these facilities creates management challenges. Breeding pairs and release candidates are selected each year at the Mexican Wolf SSP Annual Meeting and approved by the USFWS Mexican Wolf Recovery Team leader.

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# 6. Sperm Quality in Mexican Wolves and Island Foxes: Relationship to Genetic Management

CHERYL S. ASA[1], KAREN L. BAUMAN[1], SUSAN L. LINDSE[2], MARGARET CALLAHAN[3], TIM COONAN[4], KEITH RUTZ[4], PHILIP MILLER[5] AND MARY AGNEW[6]

One of the challenges in managing small populations in captive breeding programs can be problems with reproduction, such as those related to inbreeding or founder effects. Our experience monitoring reproductive parameters of Mexican gray wolves (*Canis lupus baileyi*) and island foxes (*Urocyon littoralis*) illustrates such problems. The original three Mexican wolf lineages became inbred before each was genetically certified, which was required before the lineages could be interbred. We found a significant correlation between inbreeding coefficient and poor sperm quality. Furthermore, sperm from Mexican wolves was generally of lower quality than that of generic gray wolves (*C. lupus*). Following interbreeding among the Mexican wolf lineages, sperm quality of the resulting male offspring was improved and equivalent to that of the generic wolves. In the island fox breeding programs on San Miguel and Santa Rosa Islands, about half the males, including four founders, had not reproduced. Although our semen evaluations indicated that semen quality was lower in some of the unsuccessful males, the types of abnormalities observed were not severe and need not result in infertility. Hormone profiles of the female foxes showed normal ovulatory cycles, but behavioral data that might document copulation was lacking. Mate incompatibility remains a possible explanation for reproductive failure, since island foxes like canids in general are believed to be monogamous, making mate choice an important variable. Thus, although genetic management is indeed important, behavior and social systems also should be considered.

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# HABITAT FRAGMENTATION AND LINKAGES

*Moderator: Bill Ruediger*

## 1. Human Influences on Range Contractions of North American Carnivores and Ungulates

ANDREA S. LALIBERTE[1] AND WILLIAM J. RIPPLE[2]

Knowledge of the geographical distribution of species is important for conservation biology. However, few studies have examined the dynamics of species ranges and changes over time and space. In addition, we know very little about human influences on species range changes at the continental scale. We compared the historic and current geographical ranges of 43 North American carnivores and ungulates to identify large-scale patterns in range contractions and expansions. Our objectives were to determine the degree of human influence on species range changes, to describe range changes with regard to biomes and elevation, and to describe changes in species richness. Seventeen of the species had experienced range contractions over more than 20% of their historic range. Electivity indices showed a strong correlation between human influence and species range contractions. In areas of higher human influence, species were more likely to contract and less likely to persist. Species richness had also declined considerably since historic times. The temperate grasslands and temperate broadleaf-mixed forest biomes lost the highest average number of species, while the boreal forest and tundra showed fewer numbers of species lost. Our spatial quantification at the continental scale showed that species contractions have been widespread, crossing regional and country boundaries and that this rapid collapse occurred over the course of only 1 to 2 centuries. The results of this study can be used to improve scientists' knowledge of historical reference conditions and to provide input for wildlife reintroductions and for the creation of wildlife reserves.

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# 2. Scale-Dependent Habitat Associations Within and Among Carnivores and Prey in the Canadian Rocky Mountains

SHELLEY M. ALEXANDER[1] AND PAUL C. PAQUET[2]

The potential for predictive models to be non-generalizable across scales has negative implications for management, planning and conservation. Yet, there is limited understanding of what metrics may be robust predictors for species and guilds across analytical scales. We used Principle Components Analysis (PCA) to test if 13 mammalian species consistently associate with habitat characteristics or partitioned into similar guilds at different spatial or analytical frames (e.g. 0-90 degrees versus 0-10 degrees). Species track data were collected on road right-of-ways and transects from November to April (1997-2000) in Banff National Park (BNP) and Kananaskis Country (KC), Alberta. A Geographic Information System (GIS) was used to extract habitat attributes by track density for three metrics: slope, aspect, and greenness (from LandsatTM-7). Guild level associations were observed, and included wolf-prey, cougar-prey, and lynx-prey, but these were inconsistent by landscape attribute and analytical scale. The lynx-hare guild was the most robust across scales and attributes. Individual species also showed variation in association with attributes and across scales. Aspect and slope yielded evidence of guild-level resource partitioning but was variable by analytical scale. Greenness was a consistent predictor for all species at all scales, but may have been biased by sampling effort (all areas have high greenness). We contend that landscape models (e.g. multiple valleys) may not perform well at regional scales (e.g. within a valley), despite close proximity. Thus, it is critical for managers and researchers to examine spatial-temporal and data-ranges effects before concluding predictive modeling and ascribing management actions.

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# 3. Threats to Wildlife Linkages in the New Mexico Highlands and Sky Islands Wildlands Networks

KIM VACARIU[1]

One of the greatest challenges facing conservationists in New Mexico's central highlands and in the Sky Islands region of southeastern Arizona is finding a way to maintain historic travel routes for wide-ranging species moving between important habitats. In New Mexico's Tijeras Canyon, relied upon as a travel corridor for black bear moving between the Sandia and Manzano mountain ranges, this challenge is made difficult due to the blocking of that wildlife linkage by Interstate 40 and adjacent developments. In the Sky Islands, the Border Patrol's efforts to install impenetrable security infrastructure such as fencing, all-night lighting, vehicle barriers, and roads along the U.S.-Mexico border poses equal problems for endangered species like jaguar and ocelot, which require cross-border movement. Creative solutions are needed.

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# 4. Jaguar Habitat Models and Their Utility in Conservation*

HELIOT ZARZA[1], GERARDO CEBALLOS[1], CUAUHTEMOC CHAVEZ[1] AND FERANDO COLCHERO[2]

Jaguars (*Panthera onca)*are the largest carnivores in tropical ecosystems in Central and South America. Their populations have been steadily declining due to changes in the land use and overkilling. A critical component for the long-term conservation of jaguar is to determine their patterns of activity and habitat requirements in human dominated landscapes. The largest jaguar population in Mexico is found in the Yucatan Peninsula, where habitat is still plentiful, but agriculture is becoming a major factor for habitat loss and fragmentation. Therefore the main goal of this study has been to determine the jaguars' habitat requirements at a landscape scale in of the Mayan tropical forests of the southern Yucatan Peninsula. Our work is based on data gathered from radio-collared jaguar and a Geographic Information System. To determine the effect of human impacts on the patterns of habitat use, we analyzed jaguar movements in relation to habitat type, land use, settlements, and roads. Our results indicate that jaguars prefer evergreen lowland forests, which are the kind of forest heavily used for forestry practices. We found that jaguar tended to use less frequently forest found as far as 7 kilometers from human settlements and 5 km from roads. We used those results to develop a model of potential habitat of jaguar for the region and to identify high-priority areas for the long-term conservation of jaguars.

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# 5. Designing an Ecological Network for Large Carnivore Protection in Vrancea County, Romania

ROZYLOWICZ LAURENTIU[1], POPESCU VIOREL[1] AND CHIRIAC SILVIU[2]

The Carpathian Mountains in Romania host the largest populations of large carnivores in Europe (about 50% of the population of brown bear, *Ursus arctos*, 35% of the population of wolves, *Canis lupus*, and 75% of the lynx, *Lynx lynx*, population). Vrancea County contains the second highest density of large carnivores in Romania (6.5% of bear population, 3.7% of wolf population and 5.5% of lynx population). High density is generated by the existence of low-fragmented forest habitats and also by the enforcement of a very strict management of populations during the communist regime. High density generates conflicts between large carnivores and local inhabitants, resulting in losses of human lives, economic damages, poaching and efforts related to the increased availability of individuals for hunting. With the specific aim of protecting these large populations of large carnivores, an ecological network was designed by combining space utilisation by the animals with patterns derived from landscape ecology (Patch Analyst) and with multispecies conservation value (with Ramas Multispecies Assessment). The resulting network is based on the establishment of some areas with different levels of protection and connections between them, thus reducing of the human pressure on the habitats and species. The local authorities will debate on the establishment of the ecological network, which subsequently be approved and enacted at national level.

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# CENTRAL AND SOUTH AMERICAN CARNIVORES

*Moderator: Gerald Zuercher*

## 1. Human and Predator Conflicts in Brazil: An Overview of the Last Decade of Problems and Solutions

**ROGÉRIO CUNHA DE PAULA[1] AND RICARDO LUIZ BOULHOSA[2]**

Brazil is known worldwide as one of the richest countries in biodiversity. It is also one of the emerging countries with a high development rate. Like several areas around the world, economic development has led to an increase in conflicts between wildlife and people throughout the country. The biggest problems stem from predators preying upon livestock. Although pumas (*Puma concolor*) and jaguars (*Panthera onca*) are the most frequently implicated species, there are 26 species of carnivores occurring in Brazil, and 17 have been frequently recorded as responsible for livestock depredation. 87% of the conflicts registered over a ten-year period were involving large cats, and only 4% were related to 15 other carnivore species. One of the main problems resulting in human-predators conflicts can be related to social and cultural factors, like the competition for game animals in localities where poverty and starvation are prevalent, or the poor living conditions in one particular site driving people to migrate to remote areas - usually to remnants of natural habitats. Further economic development is causing the exploitation of natural resources of areas in Central Brazil. This results in an increased contact zone between wildlife and human population, which in turn leads to the increasing rate of conflicts. Until recently, retaliatory actions were conducted. Nowadays, new efforts have been made to find new solutions for the human-wildlife conflicts in Brazil.

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# 2. Saving the Jaguar: A Model for the Long-Term Conservation of the World's Third Largest Cat

KATHLEEN CONFORTI[1]

Jaguar (*Panthera onca*) range has decreased nearly 50% over the last century and jaguar populations are threatened nearly everywhere they still occur. Although people and jaguars have long lived in close proximity, habitat destruction and land use patterns have resulted in jaguars frequently living near or on private lands. As a result, the persecution of jaguars by ranchers due to jaguar/livestock conflict is one of the major factors contributing to the decline of the species throughout its range. In order to begin devising strategies to mitigate such conflict, we first must understand ranching practices and jaguar depredation patterns. However, the sustainable conservation of jaguars will only occur if 1) this information is effectively disseminated to the ranching community, 2) the conservation community understands the rancher's perception of the problem, and 3) the conservation community actively engages the ranching community in dialogue and activities to stem the relentless killing of this cat. The mission of the WCS Jaguar Conservation Program's Rancher Outreach Program (ROP) is to create a model that will facilitate the sustainable co-existence of jaguars and cattle ranchers throughout the jaguar's natural range. Uniquely, this program recognizes not only the biological and ecological needs of the jaguar but also the social, economic, and cultural needs of the human populations that share land with jaguars. The program works at the heart of the interface of human/jaguar co-existence by applying sound livestock management practices based on strong science, with the ultimate objective of making this interface peaceful and sustainable.

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# 3. Impacts of Subsistence Hunting on the Foraging Ecology of Jaguar and Puma in the Maya Biosphere Reserve, Guatemala

ANTHONY J. NOVACK[1] AND MARTIN B. MAIN[1]

This study assessed the food habits and prey selection of jaguar (*Panthera onca*) and puma (*Puma concolor*) within hunted and unhunted segments of the Maya Biosphere Reserve (MBR), Guatemala. Food habits were determined from analysis of 76 jaguar and 145 puma scats collected within hunted and protected areas of the MBR from February 2000-August 2001. Diets of jaguar and puma were compared (1) within species, between areas with and without hunting to evaluate effects of subsistence hunting, and (2) between species, to evaluate resource partitioning between these sympatric carnivores. Origin of predator scat was determined from mitochondrial DNA, diets were identified from prey remnants found within scats, and frequency of prey in scats was compared to expected values based on prey density estimates to test the hypothesis of non-selective predation. Density of major prey was estimated using line-transect sampling. Diets of jaguar and puma, as measured by percent biomass occurrence of prey species, did not differ between protected and hunted areas. Jaguar diet was dominated by medium-sized prey, particularly armadillos (*Dasypus novemcinctus*) and coatis (*Nasua nasua*), in both protected and hunted areas. Medium-sized mammals also dominated puma diet, but large mammals constituted approximately 50% of prey biomass in both hunted and protected areas. Deer (*Odocoileus virginianus* and *Mazama sp.*) and large rodents (*Agouti paca* and *Dasyprocta punctata*) were the most important prey. A low degree of dietary overlap existed between jaguar and puma in both hunted and unhunted areas. White-lipped peccary (*Tayassu pecari*), collared peccary (*Tayassu tajacu*) and brocket deer were less abundant, and coatis more abundant, in the hunted area. Jaguar and puma in both study areas obtained similar contributions from large prey to their respective diets despite changes in the abundance of those prey.

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# 4. Telemetric Studies of Ocelot-Agouti Predator-Prey Interactions

ROLAND KAYS[1], MARTIN WIKELSKI[2], ENZO ALIAGA-ROSSEL[3] AND RICARDO MORENO[4]

Predator-prey interactions have important ecological and evolutionary implications, including regulating prey population size and driving anti-predator adaptations. However, the brief nature of these interactions makes them difficult to study, especially for vertebrates where predators are typically rare and shy. Therefore, except for open habitats where predation can be observed, we know few direct details about these interactions. Here we use automated and manual telemetry to describe the activity cycles, space use, and interactions of ocelots (*Leopardus pardalis*) with agoutis (*Dasyprocta punctata*) in the rainforests on Barro Colorado Island, Panama. Agoutis were the most important prey species for ocelots, found in 21% of 190 scats examined. Agoutis were primarily diurnal while ocelots were primarily nocturnal; both species had bouts of activity during their rest period, and were both typically active just before and after dawn. Of nine radio-collared agoutis, six were predated within one year, two survived throughout our study period, and one was not seen after its radio's batteries expired. The Kaplan-Meier annual survivorship estimate for this population was 0.31. Supplementary data (automated telemetry or remote video) for three predation events confirmed that a single adult female ocelot was the predator. No such data is available for the other three events, although physical evidence suggests they were also the result of ocelot predation. These predation events occurred in the early morning, typically between 3 a.m. and 4 a.m.; the carcasses were partially consumed before dawn, then left covered by leaves until the following nightfall. Additional analyses of telemetry data will be presented.

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# 5. Concentrations of Testosterone and Stress Levels Using Fecal Steroids in a Wild Population of Coyotes

ISABEL BARJA NÚÑEZ[1], MARÍA PIA SOTO ÁLVAREZ[2], RURIK LIST[3], ARTURO SALAME MÉNDEZ[2] AND MIGUEL ANGEL ARMELLA VILLALPANDO[2]

The physiologic analysis from scats is a noninvasive technique that provides valuable information for the conservation and management of species. The aim of this study was to examine stress levels and to analyze the testosterone concentrations for sex determination, through quantification of fecal glucocorticoids (cortisol and testosterone), in wild coyotes outside breeding period. Fecal samples were collected in November 2003, in semi-arid grasslands and scrubs within the largest complex of prairie dog (*Cynomys ludovicianus*) towns in North America, in the NW corner of Chihuahua, Mexico. Fecal glucocorticoid levels were quantified by Electro-Immune Assay. Results showed that testosterone concentrations varied between samples (0.15-66.4 ng/g feces) and these differential concentrations allowed sex determination. Comparisons between samples showed that fecal cortisol levels were low (0.09-0.85 ug/g feces) in the coyotes studied. However, it was observed that cortisol levels were higher in the fecal samples that contained higher testosterone levels (thus indicating male coyotes). The low cortisol levels detected is an indication of reduced stress on the population, which can be explained because of an abundant food supply (prairie dogs, kangaroo rats and cattle carrion) that reduces the competition among individuals and therefore the stress, and also because the samples were collected before the reproductive period, when the stress levels seem to be lower.

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# 6. The Natural History of the Little Spotted Cat in Brazil: Preliminary Report

TADEU GOMES DE OLIVEIRA[1], KATIA CASSARO[2], MARA CRISTINA MARQUES[2], ROSANE V. MARQUES[3] AND MARCOS ADRIANO TORTATO[4]

The little spotted cat (*Leopardus tigrinus*) is one of the smallest and least known cats in the neotropics. The species is currently considered "vulnerable to extinction" by the Brazilian government. Recently a broad-scale project was launched to gather information on several aspects of this felid's natural history: ecology, distribution, reproductive biology, genetic makeup, diseases, conservation threats and status. The ultimate goal is to elaborate a conservation action plan for natural populations in Brazil. Here we present some preliminary data on the little spotted cat natural history in Brazil. Study sites are located from northern to southern Brazil. Biometric results have shown that males are larger than females (2.63 kg and 2.16 kg; n = 18 and n = 13, respectively). There was no overlap between canine diameter between males and females, suggesting character displacement for resource partitioning between sexes. Average litter size was 1.13 (n = 55), with births year-round and male:female ratio of 1.33:1. Records (n = 206) were found all over the country, including the Amazon basin, most at lower altitudes (<200 m), with ca. 30oS as the southernmost limit. Habitat ranged from pristine rainforest to semiarid scrub, and even included highly disturbed areas. Little spotted cat:margay:ocelot ratio varied among locations. Average prey mass consumed was ca. 93 g. These consisted mostly of small mammals, lizards and birds. Deforestation, habitat degradation, and persecution mostly for the pet trade were considered the main threats.

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# 7. Predators and Their Habitats Revisited: A Diverse Carnivore Community and Their Habitat Associations in the Atlantic Forest of Paraguay

GERALD L. ZUERCHER[1], J.M. SHAWN HUTCHINSON[2], PHILIP S. GIPSON[3], ROBIN NAIDOO[4] AND OSVALDO CARILLO[5]

At the Carnivores 2000 conference, a preliminary predator-habitat analysis was presented from the Mbaracayu Forest Nature Reserve in eastern Paraguay. The focus at that time was using point data to investigate habitat patterns in 6 felids: jaguar (*Panthera onca*), puma (Puma concolor), and several species of small spotted cats (ocelot, *Leopardus pardalis*; margay, *L. wiedii*; oncilla, *L. tigrinus*; Geoffroy's cat, *Oncifelis geoffroyi*). Four years later, a wealth of new data inspired a return to the subject of habitat associations in this carnivore community. A new GIS approach includes canids (bush dog, *Speothos venaticus*; crab-eating fox, *Cerdocyon thous*; maned wolf, *Chrysocyon brachyurus*), mustelids (lesser grison, *Galictis cuja*; tayra, *Eira barbara*), and procyonids (coati, *Nasua nasua*; crab-eating raccoon, *Procyon cancrivorus*). Analysis using GIS has made possible the comparison of 2 models of habitat associations using point data. The first model conservatively assumes each point is the center of a home range while the second model assumes each point is on the periphery. In areas where habitat and/or species diversity make telemetric studies of an entire carnivore community problematic, analyzing point data with a GIS may provide the best method for understanding habitat associations of carnivores.

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# WOLF ECOLOGY

*Moderator: Jim Pissot*

## 1. Linking Plant Growth to Wolf Reintroduction in Yellowstone National Park

WILLIAM J. RIPPLE[1], DOUGLAS W. SMITH[2], ROY A. RENKIN[2], ERIC J. LARSEN[3] AND ROBERT L. BESCHTA[1]

We studied young aspen, cottonwood (*Populus spp*.), mountain alder (Alnus spp.), and three species of willow (*Salix spp*.)in Yellowstone National Park to examine the potential influence of wolf/elk (*Canis lupus* and *Cervus elaphus*) interactions upon plant growth. After a period of approximately 70 years without wolves, they were reintroduced in 1995-96. Plants in riparian areas were sampled using plant architecture techniques in six 1000 m transects (a different species per transect) along five streams. While none of the measured plants were taller than 200 cm in 1998, in 2001 the percentage of sampled plants taller than 200 cm ranged from 7 to 64 percent for individual transects. Less browsing was documented at sites where terrain features limited escape routes for elk. We hypothesize that a patchy release of riparian plants (previously suppressed by browsing) was due to wolves altering predation risk and patterns of herbivory by elk. Plant release was observed despite the elk population being three times higher than it was in the mid 1960s when wolves were absent and plant release did not occur. In addition, the number of beaver colonies in the study area increased from zero in 1996 to seven in 2003.

Results provide evidence illustrating the indirect effects of a top carnivore in a terrestrial food chain and supports theories on predation risk effects and trophic cascades. Thus, wolves may ultimately provide for improved habitats and sustainability of numerous species of riparian dependent wildlife.

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# 2. Wolf Den Site Selection and Characteristics in the Northern Rocky Mountains*

JON R. TRAPP[1]

Reproductive success is key to survival and persistence in any species. Gaining a better understanding of wolf (*Canis lupus*) den site selection and characteristics can help in the future management of wolves in the Northern Rocky Mountains (NRM) of the United States and elsewhere. I studied fine-scale denning habitat selection by comparing field-measured characteristics of 22 dens in Idaho, Montana, and Canada to paired random contrast sites within the pack home range. In order of importance, wolves denned in areas that had greater canopy cover, hiding cover, herbaceous ground cover, and woody debris, and were closer to water than paired random sites. Logistic regression models using these as candidate variables identified proximity to water, canopy cover, herbaceous ground cover, and small woody debris as the most important variables, and successfully categorized >81 % of dens and > 86 % of paired contrast sites. At a coarse-scale (using GIS data layers), 35 wolf dens did not differ from 35 paired random contrast sites in Idaho, Montana, and Yellowstone National Park with respect to elevation, slope, forested habitat, solar radiation, land ownership, distance to water, and distance to roads. However, a GIS model based on the Mahalanobis distance (with slope, elevation, coniferous forested habitat, and solar radiation as habitat variables) suggests that > 85% of dens will occur in potential denning habitat that occupies < 12% in the NRM.

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*student competition

# 3. Modeling Gray Wolf Distribution and Resource Selection in Coastal Temperate Rainforests of British Columbia, Canada*

PATRICIA L. SWAN[1], SHELLEY M. ALEXANDER[1], PAUL C. PAQUET[1] AND CHRIS T. DARIMONT[2]

The Pacific Coast of British Columbia, Canada, forms part of the most extensive temperate rainforest habitat remaining in the world. The island archipelago and coastal mainland of this region provides habitat for a unique, genetically distinct population of gray wolf (*Canis lupus columbianus*). Due to the remoteness of the area, little is known of coastal wolf ecology, yet development pressure from forestry, oil, and gas sectors has precipitated the need to determine the physical, biological and spatial factors that affect wolf presence in the region. Wolf presence was determined by scat, tracks, direct observation and howls during three pre-1990 field surveys and during 1999 and 2003. In total, 50 islands in the archipelago were surveyed. Geographic Information Systems (GIS) coverages were derived to extract independent variables representing physical, biological and spatial configuration characteristics of resources. Physical and biological variables included island-level (mean, standard deviation) elevation, slope, topographic complexity, northness, eastness, presence of competitor and prey species (i.e. salmon and deer), homesite presence, vegetation heterogeneity, old-growth (wetness), structural complexity (greenness), and percent harvested forest. Spatial variables included island area, shape, and distance to nearest island and mainland. Logistic regression and Akeike's Information Criterion (AIC) were used to assess a suite of candidate models. Final models will be validated with a subset of data not used in model construction and will be explored for the possibility of directional influences (i.e. N,S,E,W effect). Results will identify areas of habitat importance for coastal wolves and will be applied for conservation initiatives.

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# 4. Temporal Predictability of Depredation on Livestock and Wolf Control in Western North America

MARCO MUSIANI[1],[2], TYLER MUHLY[2], C. CORMACK GATES[2], CAROLYN CALLAGHAN[3], MARTIN E. SMITH[4] AND ELISABETTA TOSONI[2]

Due primarily to predation on livestock (depredation), some livestock producers oppose wolf (*Canis lupus*) conservation, which is an important objective for large sectors of the public. Predicting depredation occurrence is difficult, yet necessary in order to prevent it. Better prediction of wolf depredation would also facilitate application of sound depredation management actions. In this talk, we analyze temporal trends in wolf depredation occurrence and related management actions. We gathered data from wolf depredation investigations in Idaho, Montana and Wyoming, U.S. from 1987 to 2003 and for Alberta, Canada from 1982 to 1996. All information was collected in partnerships with various interest groups, including ranchers and farmers, government authorities, environmental non-governmental organizations and universities. We showed that wolf attacks occurred with a seasonal pattern, reflecting the seasonality of livestock calving, grazing practices, and seasonal variation in energetic requirements of wolf packs. Seasonal wolf attacks were autocorrelated with lags of one year, indicating annual recurrence. Cross-correlation analyses showed that limited wolf control was rapidly employed as a short-term response to depredation, and was not designed to decrease wolf depredation at a regional scale or in the long term. Available data allowed for an analysis of the U.S. compensation program, another typical depredation management response. Livestock producers were normally compensated within three months following depredation events. The timing of refunding was comparable or shorter than other compensation programs for carnivore damage employed in other regions. Our findings indicated that compensation programs could be coupled with incentives for proactive management focused on reducing losses during high-depredation seasons.

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# RARE CARNIVORE RECOVERY

*Moderator: Amaroq Weiss*

## 1. Border Cats of the Sky Islands: A Summary of Research and Detection Efforts Using Noninvasive Techniques

LISA A. HAYNES[1], C. ZOE HACKL[1] AND MELANIE CULVER[2]

In this presentation we will review and summarize a variety of efforts which are taking place to detect and study the wild felids (pumas, bobcats, jaguars, and ocelots) of the United States/Mexico border region. Researchers are using a suite of noninvasive methods, including infrared-triggered photography, DNA analysis of scat and hair (collected from "hair snares"), and old-fashioned tracking and sign searches. Other efforts include habitat mapping and GIS-based analyses to identify conservation and research priorities. In northern Mexico, these techniques have yielded data on the presence and distribution of rare cats, such as jaguars and ocelots. This information has, in turn, created the impetus for the purchase of land to protect these populations and now serves as a land-based germination point for future conservation efforts in the area. In the United States, researchers have documented the presence of possibly resident jaguars in southern Arizona. We will outline each project, discuss management implications, and recommend priorities for future work.

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# 2. Restoring Wolves to the Grand Canyon

KAREN MURRAY[1]

Although the gray wolf (*Canis lupus*) in 2003 was downlisted under the Endangered Species Act from endangered to threatened in the Western and Eastern Distinct Populations Segments (DPS), it is still considered an endangered species in the Southwestern DPS. The U.S. Fish and Wildlife Service is currently writing a recovery plan for wolves in the Southwest, which may include additional reintroductions. This recovery planning process, combined with Utah and Colorado's development of wolf management plans, and recent science supporting the potential for wolves, has focused attention on Northern Arizona as a possible recovery area. The region provides a critical link between wolves in the northwestern U.S., viable habitat in Utah, and wolves in eastern Arizona and New Mexico. It may also be the best remaining opportunity to support current Mexican wolf recovery efforts.

The U.S. Fish and Wildlife Service's successful history of reintroducing wolves has laid an important foundation for any additional reintroductions, but the process will still be long and contentious. A strong understanding of human dimensions, such as people's values, political and economic considerations, and decision-making processes, will be critical to the success of wolf restoration north of Grand Canyon National Park. Several conservation organizations have recently partnered to make wolf restoration in the region a reality. The goal of this presentation is to explain why northern Arizona is the next best place for wolves, and how this can best be achieved through a combination of biological feasibility assessments and an understanding of human dimensions.

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# 3. Cumulative Impacts and Mitigation Failure in Florida Panther Recovery

LAURA HARTT[1] AND S. WESLEY WOOLF[1]

With fewer than 100 individuals remaining, the Florida panther (*Puma concolor coryi)* is one of the most endangered carnivores in North America. The primary threat to its survival and recovery is development-related loss and fragmentation of its habitat in Western Everglades wetlands. The panther is protected under the Endangered Species Act, a statute aimed at conserving endangered and threatened species and ecosystems on which they depend. Furthermore, the National Environmental Policy Act requires federal agencies to take a hard look at potentially significant effects their proposed actions may have on the environment. In spite of these protections, agencies continue to engage in actions that adversely affect panthers and their habitat. Namely, the U.S. Army Corps of Engineers underestimates the cumulative impacts of its wetland permitting program on the species by ignoring other reasonably foreseeable projects in or near the proposed project area, failing to assess impacts of the nationwide permitting process, and refusing to assert jurisdiction over "isolated wetlands." Similarly, the U.S. Fish & Wildlife Service issues biological opinions that make little reference to cumulative impacts and that rely on flawed science that underestimates mitigation necessary to offset project impacts, thereby jeopardizing the panther and impeding its recovery.

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# 4. Black-Footed Ferret Recovery: Lessons and Future Directions

TRAVIS M. LIVIERI[1] AND J. MICHAEL LOCKHART[2]

The combination of sociology, biology and politics brought black-footed ferrets to the brink of extinction. Throughout the 20th century human activities had pronounced effects upon prairie dogs, the primary food source of ferrets. As disease ravaged the last ferret population, agencies and organizations were mired in power struggles. By 1987 only eighteen ferrets remained, and these formed the nucleus of a successful captive-breeding program. Reintroduction into the wild began in 1991, and ferret recovery commenced a slow evolution biologically, politically and socially. Progress in the national recovery program includes innovations in captive breeding, refinement of reintroduction techniques, steering committees to guide policy and biology decisions, and a peer reviewed allocation process for reintroduction candidates. By 2004, ferret recovery efforts resulted in 11 reintroduction sites with 496 known animals in the wild. Only one site is self-sustaining and viable with several other sites showing promise to sustain ferret populations. The most important lessons learned are: 1) prevent species from becoming endangered because captive breeding/reintroduction is costly and difficult; 2) recovery is more efficient when agencies and organizations communicate and outline responsibilities; 3) develop and follow sound recovery plans; and 4) public relations and outreach can improve the politics, sociology and biology associated with endangered species recovery. The future of ferrets remains a question. While the habitat to recover endangered species such as wolves and grizzly bears already exists, there is currently not enough habitat to recover ferrets. Management of prairie dogs (i.e. ferret habitat) has improved in recent years. The charismatic black-footed ferret is a flagship species and recovery of ferrets will benefit an entire ecosystem.

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# 5. Living With Wildlife at the Urban Interface

JAMES C. HALFPENNY[1]

Negative encounters are increasing between people and wildlife including deer, elk, coyotes, wolves, otters, bobcats, lions, black bear, and grizzly bears. Once the rare risk of wilderness outings, encounters now occur at or inside the municipal boundaries of towns and cites across the continent. Animal attacks make headline news and encounters have sparked a plethora of books chronicling misfortunes of attacks. Causes of encounters run the gamut from increasing human populations moving into more remote areas to luring animals into residential areas with green lawns, vegetable gardens, barbeque grills, bird feeders, pet food bowls, salt blocks, and even readily accessible pets. Efforts at carnivore recovery and protect exacerbate the problem.

City, county, and state managers are little prepared for recognizing emerging problems, mitigating developing situations, nor handling the aftermath of encounters. Reactive procedures often fail during the emotional stress of injurious or fatal encounters. Traditionally, wildlife issues are the parlance of state game and fish officials trained in managing animals in non-urban, usually hunting situations. Little research is available about the urban interface to guide managers.

This paper provides an inventory of and conceptual basis for pre-emptive programs that combine interests and talents of local residents with those of managers. Proactive programs with local involvement in research and planning provide political and supportive groundwork for reacting to negative encounters with wildlife. Existing examples of programs, including presence documentation research, citizen education, home and neighborhood preparation, encounter procedures, and conflict resolution are provided. Needed research is also suggested.

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# RAPTOR CONSERVATION

*Moderator: Caroline Kennedy*

## 1. Urban Raptors: Mitigating Threats from Electrocution and Imprinting on Humans

ELISSA OSTERGAARD[1]

Raptors can be quite common in urban areas. Tucson, Arizona, is home to at least 13 species of overwintering raptors and at least 10 species of breeding raptors, with over 250 active nests in 2004. Well-meaning residents often find fledgling raptors just learning to fly and hand them over to wildlife rehabilitators, who historically raised these birds by hand. Many orphaned raptors never learned to survive in the wild, or could not be released because they were too tame. In the early 1990s, a wildlife rehabilitator in conjunction with the Arizona Game and Fish Department (AGFD) started a nest inventory to identify nests suitable for fostering orphaned raptors, and the program is currently continued by AGFD. Recent research by the University of Arizona indicates that over 25% of Tucson's Harris's hawks (*Parabuteo unicinctus*) die from electrocution on power poles each year, and other large raptors are also susceptible. The nest inventory is now being used to identify nest territories, and AGFD coordinates closely with University researchers and local power companies to target dangerous poles around nests for installation of bird guard equipment. With the proactive efforts of wildlife rehabilitators and the local power companies, these problems are being addressed and reduced, but continued coordination and cooperation are necessary.

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# 2. Foraging Patterns of Reintroduced California Condors in the Grand Canyon Ecoregion

CHAD OLSON[1], SOPHIE OSBORNE[1] AND ELAINE F. LESLIE[1]

California Condors (*Gymnogyps californianus*) have been released annually into northern Arizona since 1996 as part of a multi-agency effort to re-establish the species. A total of 44 wild condors currently exist in Arizona and Utah. Although a supplemental food source is available year-round to the condors, we documented the condors' finding of over 120 non-proffered carcasses during 2002 and 2003. We documented carcass type, suspected cause of death, distribution of carcasses, and seasonal foraging patterns. Condors fed predominantly on elk and mule deer, but exploited a wide variety of species. The majority of carcasses resulted from hunting activity and automobile collisions. Although natural foraging by condors is an important step toward self-sufficiency, it has also led to an increase in lead poisoning, currently the greatest threat to condor recovery.

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# 3. Breeding Effort and Parental Care in Reintroduced California Condors

ALLAN A. MEE[1] AND JENNIE SINCLAIR[2]

The California condor (*Gymnogyps californianus*) is one of world's most critically endangered birds. Beginning in 1992, reintroductions have sought to re-establish wild populations and recent breeding efforts have allowed the opportunity for intensive study of breeding behavior. First nesting attempts were documented in California and Arizona in 2001 with successful hatching at three nests in southern California in 2002. The first wild-bred chick fledged successfully in November 2003. Here, we investigate parental care roles and attendance at intensively monitored nests in California. Condors laid eggs between Feb 13 and Mar 31. Incubation shift lengths ranged from 0.1 to 9.1 days with females tending to attend nests for longer periods (3 out of 4 nests monitored). Nest attendance shifts declined dramatically at hatching from a mean of 2.5 to 0.6 days. Adults attended nests constantly during the first month of the brood phase. Attendance declined after this with brooding and overnight nest attendance ceasing at day 30-35 and day 33-49 respectively. Feeding rates (events/hr) at one well-studied nest declined from 0.33/hr in the first month to 0.14/hr afterwards. Feeding rates at a second nest were apparently lower (0.02-0.10/hr). This compares to 0.50/hr in week one and 0.09-0.12/hr at nests in the 1980s. We discuss parental care roles, nest attendance and feeding rates in comparison to the wild population of the 1980s and implications for future breeding attempts and population management.

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# 4. The Northern Aplomado Falcon and Implications for Reintroduction Policy

NICOLE J. ROSMARINO[1]

The northern aplomado falcon (*Falco femoralis*) is listed as endangered under the Endangered Species Act and was thought to have been extirpated from the U.S. portion of its range by the 1950s, as a result of pesticide use and habitat degradation. Plans are underway by the Fish and Wildlife Service (FWS) and the Peregrine Fund to reintroduce aplomado falcons into New Mexico and possibly southeast Arizona. Northern aplomado falcons have been reintroduced into south and west Texas over the past decade, and at least 37 pairs of aplomados now occur in the wild in that state. Reintroductions in Texas have been conducted under a safe harbor agreement, which reduces restrictions on private landowner activity in order to facilitate landowner participation in the reintroduction program. The Texas safe harbor agreement's term is 99 years and includes a "no surprises" provision. In the New Mexico context, there is substantial federal land suitable for falcon restoration. FWS will likely issue a proposed rule this year to designate reintroduced falcons in New Mexico as "experimental, non-essential," thus significantly reducing federal protection of their habitat under the Endangered Species Act. Current threats to falcon habitat in the U.S. include oil and gas activities, livestock grazing, and prairie dog extirpation. This talk will describe and assess different legal frameworks for falcon reintroduction into New Mexico and Arizona.

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# WOLVES AND LIVESTOCK

*Moderator: J. Christopher Haney*

## 1. Introducing Non-lethal Deterrents to Livestock Depredations in Southwestern Alberta

JIM PISSOT[1] AND CHARLES MAMO[2]

Ranching is a cultural and economic mainstay along the eastern slopes of the Rocky Mountains in southwestern Alberta. Wolves (*Canis lupus*) overlap grazing lands in this region, preying on wild ungulates, other native prey, and livestock. Aside from Waterton and Banff national parks, there are no areas where wolves are free from potential livestock conflicts or from aggressive trapping and hunting and occasional poisoning. Wolves were extirpated from this part of the province on at least two occasions in the last century; the population has recovered with recolonization from outside the region. The Province of Alberta actively encourages trapping to control wolf numbers, compensates ranchers for livestock losses to wolves, and removes "offending wolves where chronic depredations occur." Current provincial policy envisions "maintenance of about 50 wolves in southwestern Alberta to assist in ongoing wolf recovery in the northwestern [U.S.] states."

The Central Rockies Wolf Project, Southern Alberta Conservation Cooperative, Defenders of Wildlife Canada and other organizations have worked for several years to understand wolf behavior in the region, reduce livestock depredations, assist ranchers, and gain support for more tolerant wolf management and conservation. Efforts have included surveying rancher attitudes and ranching methods, monitoring wolves, reporting wolf presence and movement to local ranchers, advising on techniques to reduce depredations, and cooperating with the Alberta Fish and Wildlife division.

We discuss depredation events in the spring of 2003 and the response of local ranchers, the conservation community, and provincial authorities. Following the initial depredations, Alberta Fish and Wildlife radio-collared members of the suspected wolf pack, Defenders Canada and others contracted to have the wolves monitored and to report wolf activities to local ranchers and provincial agents, and to assist ranchers. Depredations continued through the summer and fall; most of the wolf pack was destroyed by the end of the year.

We discuss the potential for wolf conservation where pack home ranges overlap with livestock grazing and where wolves are subject to liberal hunting and trapping policy. What non-lethal options are available to ranchers and other landowners to reduce the likelihood of depredations? How might ranchers be supported in these options? How might the province's compensation program be improved? What changes in provincial land and wildlife management policies might reduce wolf-livestock conflicts? What parallels exist between current wolf management in Alberta and potential management of de-listed wolves by states in the U.S.?

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# 2. Assessing Factors Related to Wolf Depredation of Cattle in Fenced Pastures in Montana and Idaho*

ELIZABETH H. BRADLEY[1] AND DANIEL H. PLETSCHER[1]

Managing wolf (*Canis lupus*) depredation on livestock is expensive and controversial, therefore managers seek to improve and develop new methods to mitigate conflicts. Determining which factors put ranches at higher risk to wolf depredation may provide ideas for ways to reduce livestock and wolf losses. We sampled cattle pastures in Montana and Idaho that experienced confirmed wolf depredations (n = 34) from 1994-2002 and compared landscape and selected animal husbandry factors with cattle pastures on nearby ranches where depredations did not occur (n = 62). Pastures where depredations occurred were more likely to have elk (*Cervus elaphus*) present, were larger in size, had more cattle, and grazed cattle further from residences than pastures without depredations. Using classification tree analysis, we found that a higher percentage of vegetation cover was also associated with depredated pastures in combination with the variables above. We found no relationship between depredations and carcass disposal methods, calving locations, calving times, breed of cattle, or the distance cattle were grazed from the forest edge. Most pastures where depredations occurred during the wolf denning season (April 15 - June 15) were located closer to wolf dens than nearby cattle pastures without depredations. Physical vulnerability, especially of calves, may also increase risk of depredation.

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# 3. The Nature of the Beast: Wolf Conflicts and Conservation in the Northern Rockies

SUZANNE A. STONE[1], NINA FASCIONE[2], GINA SCHRADER[2], AMAROQ WEISS[3], PAUL SNEED[4] AND MARCO MUSIANI[5,6]

As wolves (*Canis lupus)* expand their range in the northern Rockies, associated conflicts with humans are inevitable. These conflicts often deepen negative social attitudes, which significantly affect wolf management, its costs, and the species' survival. In 1987, Defenders of Wildlife initiated conflict mitigation initiatives such as compensating livestock owners for wolf-related losses. To date, the program has provided over $320,000 through The Bailey Wildlife Foundation Wolf Compensation Trust, representing nearly all confirmed wolf depredation losses in the region. Additionally, Defenders has contributed over $200,000 in nonlethal deterrents and technical assistance to livestock owners. Investment in nonlethal control measures and improved livestock husbandry help reduce both losses and associated conflicts. By comparison, traditional lethal control programs are expensive, sometimes dangerous to human life, promote a relentless cycle of killing wolves, and provide, at best, only short-term results with respect to livestock protection. In 2004, we began surveying compensation recipients to evaluate the effectiveness of the livestock compensation program and to determine the level of interest in using nonlethal and proactive methods. Most respondents said they were "somewhat" to "highly satisfied" with the amount of compensation they received for their losses. Sixty-four percent of respondents stated that their tolerance toward wolves would be "moderately" to "significantly" lower if the compensation program ended. Additionally, the majority stated that Defenders' wolf compensation program should continue once wolves transfer from federal to state management. Most respondents also indicated an interest in learning about nonlethal methods, indicating supportive conditions for increased use of these management tools.

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# 4. Predicting the Geography of Potential Wolf-Livestock Conflict in Utah: A GIS-Based Approach to Proactive Depredation Management

TREY SIMMONS[1], DAVID GALBRAITH[1] AND JOAN DEGIORGIO[2]

After a 70-year absence, wolves (*Canis lupus*) are now beginning to return to Utah. As in other states, wolf recovery in Utah is a politically charged issue, often pitting wolf advocates against livestock producers. Defenders' cooperative efforts to reduce depredation on livestock using nonlethal methods is gaining acceptance among producers in the northern Rockies; such programs may help to increase tolerance for wolves in areas where depredation has been an issue. The purpose of this project is to target cooperative programs in nonlethal depredation management to areas where conflicts between wolves and livestock are likely to occur, but before wolves actually arrive. Where those areas also have significant conservation value for other species, they may be appropriate targets for conservation easements as well. To identify those areas with a high potential for wolf-livestock conflict, we used a GIS-based approach. We used habitat predictors of wolf occupancy and prey distribution to develop a habitat model for wolves in Utah. We then combined that map with data layers that represented land ownership, sheep distribution and densities, and cattle distribution and densities to generate a map showing a gradient of conflict potential. The habitat model revealed extensive areas of potential wolf habitat, over 40,000 square kilometers statewide. Although areas with a significant potential for conflict were also located across the state, we focused on northeast Utah, where wolves are likely to establish first. We are now in the process of contacting producers and evaluating on a site-specific basis the potential for easements.

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# 5. Experimental Assessment of a Non-lethal Control Method for Reducing Wolf-Human Conflict*

JASON E. HAWLEY[1], THOMAS M GEHRING[1], RONALD N. SCHULTZ[2], ADRIAN P. WYDEVEN[2], PEGGY CALLAHAN[3]

Few studies have used a rigorous experimental approach in testing non-lethal methods for controlling depredating wolves in semi-agricultural landscapes. The goal of this study is to examine a specific method of non-lethal control, site-aversive conditioning through the use of electronic training collars, or shock collars. Completion of the first field season in northern Wisconsin (September 2003) has provided results that strongly suggest shock collars can be used as an effective tool in altering wolf behaviors and movements away from regularly visited areas (baited trail intersections). Shock zone visitations by shock-collared wolves dropped nearly 93% from the 14-day pre-shock period to the 14-day shock period. Shock zone visitations by non shock-collared wolves (control) actually increased by nearly 76% from the pre-shock period to the shock period. Our second field season will begin May of 2004. During this season, we hope to increase our sample size from 3 treatment packs to 9 or 10. If proven to be a viable management technique, site-aversive conditioning could be used to manage established (e.g. Minnesota), naturally recolonizing (e.g. Michigan and northern Maine), and reintroduced wolf populations (e.g. southwestern U.S.) that occur in semi-agricultural landscapes.

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# 6. Grazing Retirement: An Important New Approach to Large Carnivore Conservation

HANK FISCHER[1] AND TOM FRANCE[2]

Select livestock grazing allotments in the Northern Rockies experience chronic conflict with wildlife, especially large carnivores such as grizzly bears and wolves. Many of these allotments lie immediately adjacent to national parks or designated wilderness that form core conservation areas. Other allotments are located in important wildlife corridors. This conflict is both a source of mortality and an impediment to population expansion.

Traditional advocacy approaches to changing grazing patterns on public lands have enjoyed limited success. The National Wildlife Federation believes that a market-based approach, where conservationists pay ranchers to retire their grazing permits, can help redefine where grazing occurs on public lands. Through this voluntary process, NWF has retired seven livestock grazing allotments totalling approximately 125,000 acres at a cost of about $450,000 since 2002. This project has involved extensive collaboration not only with livestock permittees, but also with conservation partners (including Defenders of Wildlife) who have supported and helped fund various projects. In this presentation, we will describe how the retirements were achieved and discuss the challenges associated with allotment retirement.

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# 7. Integrating Livestock Husbandry and Large Carnivore Biology: Development of Proactive Comprehensive Techniques to Reduce Large Carnivore-Livestock Conflicts in the Rocky Mountains

TIMMOTHY KAMINSKI[1], KYRAN E. KUNKEL[2], CHARLES MAMO[3], VAL ASHER[2], JAMES PISSOT[4] AND JANELLE HOLDEN[5]

We propose a 'working model' and practical approach for reducing large carnivore-livestock conflicts that integrates livestock husbandry techniques with carnivore biology. By scaling our application of modified livestock husbandry techniques such as range riders during summer-fall, and barriers such as fladry during winter-spring to the annual area used by wolf packs, we speculate that livestock depredations by gray wolves can be significantly reduced. We provide context for understanding wolf depredations on livestock as an underlying premise for our approach by relating traditional livestock husbandry techniques and seasonal changes in ungulate prey distribution to wolf life history characteristics and livestock depredation data in Montana, Idaho, Wyoming and Alberta. We then review criteria for evaluating joint-learning between livestock producers and biologists, assess progress for application of depredation avoidance techniques in Alberta and western Montana, and outline the inclusion of these efforts in a comprehensive approach for their application and evaluation. We suggest that such comprehensive proactive efforts, as compared to 'piece-meal' paradigms, be evaluated as integral to a programmatic effort toward managing livestock depredations, large carnivore-livestock conflicts, indemnity payments, and conserving ungulate and large carnivore populations amongst wildland areas and ranching communities across landscapes in the Mountain west.

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# REMOTE CAMERA SURVEYS IN CARNIVORE RESEARCH

*Moderator: Andrew W. Trites*

## 1. A Comparison of Non-Invasive Techniques for Detecting Three Forest Carnivores: Conservation Detector Dogs, Remote Cameras, and Hair Snares

ROBERT A. LONG[1], THERESE M. DONOVAN[1], PAULA MACKAY[1], WILLIAM J. ZIELINSKI[2], JEFFREY S. BUZAS[3]

Non-invasive approaches to studying the distribution and ecology of carnivores have become increasingly common. Innovative devices such as track plates, remote cameras, and hair snares can be used to evaluate occurrence and distribution of rare or secretive carnivores. Conservation detector dogs—dogs trained to detect some entity relating to wildlife such as scat or carcasses—have recently been added to the researcher's toolbox. When combined with molecular techniques (e.g., extraction of DNA or stress hormones from hair or feces), the use of detector dogs can provide information previously available only through radio telemetry or extensive direct observation.

We used trained "scat-detector dogs" to systematically locate scats from black bears (*Ursus americanus*), bobcats (*Lynx rufus*), and fishers (*Martes pennanti*) on more than 150 sites in Vermont. We also deployed remote cameras and hair snares on many of these sites. Dogs were able to detect the three target carnivore species at a much higher rate than either remote cameras or hair snares, and with less effort. We report on detection rate, probability of detection, limitations, and study design considerations for each method.

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# 2. Ocelot Home Range and Density in Belize, Central America

ADAM G. DILLON[1] AND MARCELLA J. KELLY[1]

This study has two primary goals. The first is to adapt and apply camera trapping techniques previously used to estimate densities of jaguars to a smaller, tropical rainforest felid, the ocelot (*Leopardus pardalis*). This camera trapping method will be used to estimate and compare the density of ocelots in the rain and pine forests of Belize. Second, this study will determine the home ranges of ocelots in the tropical rainforest of Belize using traditional radio telemetry techniques. Home range estimates produced using radio telemetry will also be compared to estimates produced using camera trapping techniques to examine the potential of camera trapping to analyze home range. This study will result in the first density and home range estimate of ocelots in Central America and therefore provide baseline information for conservation of the species.

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# 3. Use of Remote Cameras and Mark-Recapture Statistics to Estimate Puma Densities in Central America

MARCELLA J. KELLY[1] AND HILARY B. CAMBLOS[1]

The elusive, solitary, wide-ranging, and often, nocturnal behavior of free-living pumas (*Puma concolor)* make them difficult to study and/or survey. In addition, pumas have only subtle markings making individuals difficult to distinguish. As a result, little is known about puma densities in the wild. We used remotely triggered cameras to survey pumas in the Chiquibul Forest Belize, Central America in 2002 and 2003. Cameras were placed in grid-like formation with 3-km interval spacing between camera-trapping stations. Each station consisted of an opposing pair of cameras that were operational 24 hours a day for 30-90 days per survey. Individual pumas were distinguished in photographs by subtle markings in the coat patterns (especially tail tips and undersides of legs) and scaring patterns. Capture histories were established for each individual puma and mark-recapture statistics (specifically program CAPTURE) used to estimate puma numbers. These population size numbers were then divided by the effective area surveyed to determine puma density. Effective area surveyed was determined by creating a buffer surrounding each trap station with a radius equal to half of the mean maximum distance moved by each puma between stations. This resulted in survey areas of 324.5 and 461.6 $km^2$ for the two separate surveys and density estimates of 4.31 and 7.15 pumas per 100 $km^2$. This study demonstrates the effectiveness of remote cameras for density estimation of pumas and highlights the potential for application of this technique to puma populations in other parts of the world.

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# 4. Monitoring Jaguar Populations Using Camera Traps: Abundance Surveys in the Cockscomb Basin, Belize

SCOTT C. SILVER[1] AND LINDE E.T. OSTRO[2]

The authors will present the results of three consecutive years of a jaguar (*Panthera onca*) abundance study in the Cockscomb Basin jaguar reserve in Belize, Central America. The survey results for at least 4 individual surveys will be presented. The abundance surveys were conducted using remote camera trapping to estimate a population based upon a closed population mark and recapture analysis. The results indicate a relatively high density of jaguars at this site when compared to other studies using similar techniques. Differences in density estimates between successive surveys will be presented, and we suggest that variation in the buffer area included in the analysis is chiefly responsible for this variation. The authors will suggest possible alternative methods for calculating the buffer area beside the mean maximum distance moved (MMDM) of animals recaptured. The presentation will emphasize the methodology of using mark and recapture analysis to estimate abundance in individually recognizable species, and will outline some of the promises and limitations of the method for investigating felid population status and ecology.

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# 5. Monitoring the Behavior of an Elusive Carnivore with Remote Camera Systems: Folly or Panacea?*

SADIE S. STEVENS[1], ROBERT C. CORDES[1] AND THOMAS L. SERFASS[1]

Since 1982, the Pennsylvania River Otter Reintroduction Project has released river otters (*Lontra canadensis*) into seven waterways in north-central and western Pennsylvania. Unfortunately, effective methods have not been developed to estimate population densities associated with these or other otter populations. Surveys for sign (primarily scats deposited at latrine sites) have been used in numerous studies to determine presence or absence of otters, but this approach does not provide a reliable estimate of the number of individuals contributing to the scat-marking. We are using remote cameras to evaluate behavior and group composition of otters at latrines with the intent of determining if scats can be used to estimate population density. We have developed methods for using remote camera systems to photograph and videotape otters at latrine sites along the Youghiogheny River in southwestern Pennsylvania and Tionesta Creek in northwestern Pennsylvania. We describe problems encountered while using remote camera systems and the equipment and procedures devised to avoid those problems. The techniques we have developed have greatly enhanced detection rates, enabling us to obtain 83 photographic and 47 video events of river otters at latrine sites. Although there are inherent pitfalls in monitoring river otters and other elusive carnivores using remote camera systems, this technology can yield behavioral and other information otherwise unobtainable by traditional survey methodologies. We believe that the approaches we have developed can increase success rates when using remote cameras to monitors otters and other carnivores.

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# 6. Forest Carnivore Camera Surveys in Northern California: Lessons Learned from Methodology and Results

STEPHANIE L. WALDO[1] AND TRISTAN BERLUND[1]

Forest carnivores and their associative patterns with mature forest habitat components, such as canopy closure and tree size, have recently been the subject of much debate in Northern California. A great deal of effort has been spent surveying for four target species: Sierra Nevada red fox (*Vulpes vulpes necator*), wolverine (*Gulo gulo*), American marten (*Martes americana*), and the Pacific fisher (*Martes pennanti*) on National Forest lands. Garcia and Associates conducted numerous carnivore surveys using baited camera stations within the Plumas National Forest, California while under contract with the U.S. Forest Service. We sampled five different project areas for a total of 262 stations over two years. Our surveys were conducted following the survey protocol described by Zielinski and Kucera (1995). Despite rigorous effort, with 8,712 camera days over approximately 165,190 acres, none of the four target species were detected. During that time period we experienced malfunctions, logistical difficulties, and animal disruptions that resulted in 349 days of lost data. However, our efforts yielded more efficient techniques, suggested changes in protocol, and realized specific habitat components of these camera sights, which may or may not be related to the lack of special status species detections, and specifically those of the American marten.

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# 7. The Importance of "Gravy Data": Getting the Most Out of your Photosurvey Effort

JOHN D. PERRINE[1] AND REGINALD H. BARRETT[1]

As part of a comprehensive ecological study of red fox (*Vulpes vulpes*) in the Lassen Peak region of northern California, we pooled the results from more than 1000 baited TrailMaster camera stations operated in the area by various agencies from 1992 through 2002. Although many of these stations had not been established with the explicit goal of detecting red fox, the resulting database gave valuable insight into their distribution, habitat use and activity patterns. The database also illustrated the enormous potential of photostation surveys to collect useful data on a wide range of species, even those species not of interest at the time of the survey. We refer to this supplemental data as "gravy data," as it comes along with data on the primary focus, or "meat," of the survey. For example, cameras established to detect red fox can also provide data on potential competitors and prey species, as well as unrelated species such as gray jay (*Perisoreus canadensis*). Gravy data is not free, but can be obtained with far lower marginal costs. As additional surveys are conducted, the collective value of gravy data can match or even exceed the value of the data for which the surveys were originally conducted. But the value of gravy data is limited by its availability. We present several recommendations to maximize the value of gravy data during the collection, analysis and storage of photosurvey results. Many of our recommendations would also improve data quality on the species of current survey interest, providing short-term benefits for the surveying agency as well as long-term benefits for researchers interested in analyzing the gravy data.

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# AFRICAN CARNIVORES

*Moderator: Rosie Woodroffe*

## 1. Establishing Conservation and Research Priorities for African Carnivores

JUSTINA C. RAY[1] AND LUKE HUNTER[2]

Establishing conservation priorities has become increasingly critical in the face of dwindling resources. With larger carnivores frequently among the taxa to first disappear, intact assemblages generally signal those biological communities that have experienced the least adverse impacts emanating from the human footprint. The aim of this priority-setting exercise was to establish conservation and research priorities both for the species themselves, and as a vehicle for determining geographic priorities on the continent. The two components of the study were: 1) establishing species-specific priorities, and 2) analyzing geographic patterns of intact carnivore communities. We focused on 20 large and medium-sized African carnivores (>7 kg), on the premise that the relative impact of the species on other components of biodiversity, the likelihood of being affected by human activity, and the information base were likely to be greatest with larger-bodied species. For the priority-setting exercise, we used three sets of criteria: 1) innate biological characteristics, 2) state of knowledge, and 3) specific threats. We developed an objective scoring system for all three categories, which were evaluated separately to understand their interrelationships. Analyses revealed a correlation between research effort and vulnerability, with those species that are the most vulnerable and exposed to specific threats also having received the most research attention. Degree of habitat specialization and restricted distribution were also important variables. 70% of the continent has experienced range loss of between 1-3 species, with different geographic regions and families exhibiting differing patterns of species loss. Many data-deficient species are becoming the new apex predators in communities that have experienced loss of larger carnivores.

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# 2. Social Structure of the World's Most Endangered Canid, the Ethiopian Wolf, Elucidated by Genetic Methods

JOHN P. POLLINGER[1], DEBORAH A. RANDALL[2], PRINCESS GILBERT[3], DAVID MACDONALD[2] AND ROBERT K. WAYNE[3]

The Ethiopian wolf (*Canis simensis*) is the world's most endangered canid. Endemic to the Northern and Southern Highlands of Ethiopia, it numbers at less than 500 individuals. Elucidation of their social structure is critical to guide conservation efforts. Field observations indicate that Ethiopian wolves exhibit unique social structure compared to other social canid species, e.g. gray wolves (*Canis lupus*) and African wild dogs (*Lycaon pictus*). The observation of female dispersal and male philopatry create the potential for extra-pack copulation and inbreeding avoidance through mating outside of alpha male-alpha female pairings. However, observations cannot robustly identify all unique individuals and their pedigree within and between packs. Thus, we genotyped 84 individuals from 9 packs using 11 nuclear microsatellites to determine pair-wise genetic relatedness between all the individuals along with the parentage of 27 pups. Genetic relatedness analysis for each pack revealed high male relatedness confirming male philopatry and low female relatedness confirming female dispersal. In addition, parentage analysis revealed multiple cases of extra-pack copulation. While most parent pairs correlated with alpha male-alpha female pairing, fathering was not explicitly by alpha males. The unique social structure has major ramifications on conservation management to ensure the survival of this critically endangered species.

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# 3. Building Partnerships: Culture-Based Wild Dog Conservation in Southern Kenya

E. KIM MCCREERY[1] AND ROBERT L. ROBBINS[1]

The African wild dog (*Lycaon pictus*) is among the most endangered canids. Recent information confirms the presence of this canid in the semi-arid region of southern Ethiopia, suggesting that the Horn of Africa may sustain a wild dog population. Scant information is available on the conservation status and distribution of this species in southeastern Kenya bordering Somalia. Several sightings dating as far back as 1976 have been reported, but civil strife and continued perception of security risks have severely limited access to this region. Reconnaissance to the southernmost district (Ijara District) of the Northeastern Province, home to predominantly Islamic Somali herdsmen, confirmed the presence of packs. Partnerships were initiated with local and national stakeholders to establish a community-based wild dog conservation project. Preliminary biological and social assessment field surveys were conducted. Thereafter, a questionnaire designed to systematically assess social attitudes towards wild dogs in particular, and large predators in general, was field tested by two nationals. Here we provide updated information on *Lycaon* in the region and present a preliminary social assessment of attitudes towards wild dogs and other predators. We discuss the influence of the Qur'an on local attitudes towards this species and cultural traditions on developing partnerships and implementing a community-based project.

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# 4. Livestock Predation by Lions and Other Carnivores on Ranches Neighboring the Tsavo National Parks, Kenya

BRUCE D. PATTERSON[1], SAMUEL M. KASIKI[2], EDWIN SELEMPO[3] AND ROLAND W. KAYS[4]

Conflicts with humans stemming from depredations on livestock are largely responsible for the catastrophic decline of African lions (*Panthera leo*), an estimated 50-90% decrease in only 25 years. Understanding patterns associated with such predation can be used to mitigate its effects and promote continued coexistence of lions and human. We analyzed attacks on livestock over a four-year period on two arid-land ranches neighboring Tsavo East National Park, Kenya. A total of 312 attacks claiming 433 head of stock were examined. Lions were responsible for 85.9% of the attacks; spotted hyenas and cheetahs were the other predators responsible. Lions and hyenas attacked mainly cattle and did so at night, whereas cheetahs almost exclusively took smaller sheep and goats. There was no temporal autocorrelation of daily losses, suggesting that the attacks are independent events. Both number of attacks and number of stock killed showed significant seasonal differences, and their monthly totals correlated positively with precipitation. Intensified predation in the wet season differs from patterns of lion predation elsewhere but reinforces the pattern that large carnivores take more livestock when native prey are most difficult to find and kill. On average, wildlife attacks claimed 2.4% of range stock annually, and livestock represented about 5.8% of the diet of ranch lions. This predation represented 2.6% of the herd's estimated economic value, and cost the ranches $8,749 per annum. Each lion cost ranchers approximately $290 per year in depredations.

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# 5. Reintroducing the African Lion in South Africa: Short-Term Success but Is It Conservation?

LUKE HUNTER[1], ROB SLOTOW[2], GUS VAN DYK[3] AND SOPHIE VARTAN-MCCALLUM[4]

Once distributed though most of Africa, the African lion (*Panthera leo*) has undergone an extreme reduction of range in historical times and survives largely in protected areas. Lions are persecuted intensely outside parks and reserves, and the species continues to decline through most of its African range. South Africa represents a reversal of that trend in that lions are being reintroduced into areas of their former range throughout the country. Since 1992, wild lions have been reintroduced into at least 21 privately and publicly-owned reserves covering a combined land area of 4560 km$^2$. Soft-release methods and perimeter fencing are routinely used to overcome the historical problems of large felid reintroductions and have resulted in high survivorship, successful reproduction, and rapid re-establishment of the species in many areas. The short-term technical and biological challenges facing lion reintroduction have essentially been overcome, but the long-term conservation value of these projects remains equivocal. All reintroduction sites are smaller than 1000 km$^2$ and most are isolated from other lion populations. Rapid population growth of reintroduced lions and minimal prospect for natural immigration and emigration is presently being addressed by an intensive management effort that includes translocation, contraception, sterilization and hunting. In this paper, we review the short-term successes made in efforts to reintroduce lions and discuss the obstacles confronting these projects in making an enduring contribution to the conservation of the species.

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# 6. Competititve Exclusion of Endemic Predators by Invasive Domestic Carnivores in Madagascar

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Ankarafantsika National Park, Madagascar is home to two species of endangered endemic carnivore, fanalouc (*Eupleres goudotii major*) and fossa (*Cryptoprocta ferox*). Threats to these populations include habitat loss from fire, agriculture, and lumber poaching, as well as competition and disease transfer from domestic dogs and cats. In 1999, relatively few invasive competitors inhabited Ankarafantsika's forests. In our research area, non-endemic predator numbers and biomass now greatly exceed that of endemics. Using trapping data collected from 1999 to 2004, we chart the gradual competitive exclusion and decline of an endemic carnivore population, owing to a population increase and range expansion of invading domestic carnivores. Furthermore, via scat analysis, we provide evidence and impacts of predation upon a myriad of endemic prey species by domestic dogs. Intervention and control of these invading populations is now a high management priority, yet the situation is far from in-hand.

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# POSTERS

## Human-Predator Conflict In and Around Itanagar Wildlife Sanctuary, Arunachal Pradesh, India

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A survey of predator attacks on mithun (*Bos gaurus frontalis*), a semi-domesticated bovid, was carried out in villages near Itanagar Wildlife Sanctuary, Arunachal Pradesh, Northeast India. Dhole (*Cuon alpinus*), tiger (Panthera tigris), leopard (*Panthera pardus*), clouded leopard (*Neofelis nebulosa*) and Himalayan black bear (*Selenarctos thibetanus*) are known to kill mithun. The villages are inhabited by an ethnic tribe named Nishis who were reported to kill predators, particularly dhole, in retaliation. The methods adopted to document the problem were forest trail and village surveys (to assess the status of the forests, the wildlife present around the villages, status of mithun and its influence on socio-economic conditions) and a review of earlier surveys. An analysis of the wild species reported in the region shows more species of predators (56 %) than prey (44 %). While the encounter rate for mithun was as high as 3.43/km, the rate for all deer species was as low as 0.29/km. The frequency of occurrence of mithun signs was highest (64%) as compared with canids (14%) and deer (5%). The low density of optimal prey species, relatively high density and encounter rate of cattle and the free ranging nature of mithun are responsible for the conflict. The loss of mithun to the local people is high, both economically and sentimentally, as mithun plays an important role in the culture and tradition of the Nishis. The survey also provides a set of recommendations for further understanding of the issue and conflict mitigation.

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# Population Genetic Structure of an Invasive Carnivore in the Caribbean

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The small Indian mongoose (*Herpestes javanicus*) was introduced onto Caribbean islands in the late 19th century to control pest populations on plantations but became a devastating generalist predator in the region, currently implicated in the near-extinction of many native species while threatening already dwindling populations of local ground-nesting wildlife. Effective mitigation of the ecological and economic impacts of this exotic carnivore is often strengthened by a further account of the introduced species' colonization pattern and its adaptive and evolutionary capacity. In an effort to evaluate these issues, we examined the spatial distribution and structure of genetic variability of *H. javanicus* from across the mongoose's Jamaican range, which represents the oldest non-native population of this species. Sequenced data results from the hypervariable segment of the mtDNA control region in 114 individuals from 4 localities revealed that the Jamaican population of *H. javanicus* maintained rare alleles and moderate levels of genetic variability despite having passed through a founder bottleneck. The level of genetic variability implies that the original colony was genetically diverse and further maintenance may be due to a variety of factors including mutation, local adaptation, and rapid population expansion immediately following colonization. These findings suggest that *H. javanicus* is capable of adaptively responding to different management strategies, which may render blanket pest control methods ineffective. From a conservation perspective, these results highlight the importance of population growth following a bottleneck, which largely influences the severity of genetic consequences.

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# Message Transmitter Linked With Data Logger to Aid With Aversive Conditioning of Problem Black Bears in Yosemite National Park

STEWART W. BRECK[1], NATHAN J. LANCE[1], JEAN B. BOURASSA[1] AND SEAN MATTHEWS[2]

Aversive conditioning is advantageous for managing large carnivores like bears or wolves because people can alter the application stimulus (e.g., cracker shells and rubber bullets) depending on the context of the management situation. Using aversive conditioning requires that personnel know when an animal is in an area where they may be problematic (e.g., campground, garbage dump, calving pasture). We developed and tested a new system (i.e., remote alarm) that alerts personnel when a radio-collared animal enters a predefined patch like a campground. The remote alarm combines the monitoring capabilities of data loggers with a message transmitter that sends a voice message via 2-way radios when an animal has entered a monitored area. Ensuring the remote alarm activates only when a radio-transmittered animal is in a predefined patch requires understanding and controlling factors that influence signal detection by the data logger. Validation tests demonstrate the variability in signal strength due to transmitter orientation, which influenced whether data loggers recorded the presence or absence of individuals in a predefined patch. Tests of the remote alarm, used to alert park personnel of the presence of problem black bears in Yosemite National Park, quadrupled the sightings of problem black bears in campgrounds from (5% to 20%) and decreased the number of visits by bears to campgrounds. Description of the remote alarm, tests of the data loggers and field trials in Yosemite will be provided.

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# The Human Dimension of Protected Area Carnivore Conservation*

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Large carnivores, specifically cougars (*Puma concolor*) and wolves (*Canis lupus*), are a fundamental ecological component of the greater Pacific Rim ecosystem. Wildlife observational data over the past 30 years indicate that large carnivore populations are at risk due to the cumulative effects of human activity on the landscape. This poster presents the investigation of a long-term approach to carnivore conservation for a protected area, Pacific Rim National Park Reserve (PRNPR) in British Columbia, Canada, undertaken in consultation with members of an advisory group comprised of researchers, academics, and park staff. Faced with management decisions to reduce wildlife-human conflicts while conserving species, carnivore conservation at PRNPR is a complex of biological and social issues. While knowledge gaps exist in the field of natural science regarding carnivore ecology in the region of PRNPR, the purpose of this study is to better understand the human dimensions of their conservation. Following a comprehensive literature review, surveys of park visitors and interviews with local community members were conducted in the summer of 2004 to assess knowledge, perceptions, and attitudes around the topics of carnivore conservation and ecology will be conducted. Survey information will be employed to construct a base line for biophysical research. This phase of the study focuses on cougars along the West Coast Trail Unit of PRNPR using proven survey techniques.

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# The Bozeman Pass Wildlife Linkage and Highway Safety Study

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Regional-scale connectivity analyses conducted by American Wildlands (AWL) identified the Bozeman Pass area as a key linkage area, or corridor, for wildlife movement in a regional context. Landscape-scale analyses by the Craighead Environmental Research Institute (CERI) have refined the focus and corroborated the importance of the Bozeman Pass area. Landscape-scale analyses at a finer scale by CERI and AWL identified three areas with the best habitat and highest degree of connectivity as determined by least-cost-path analysis. A habitat suitability model was developed using forest carnivores as a suite of focal species. Model predictions were augmented by road-kill data, remote cameras, and winter track counts. The westernmost linkage area was determined to also be the region of greatest carnivore road-kill. In collaboration with the Montana Department of Transportation a mitigation project was developed to take advantage of a bridge rebuild in the area and to install wildlife exclusion fencing and moose guards so that wildlife could be re-directed underneath the highway through existing bridges and culverts. The fencing project will be constructed in 2005; monitoring of road-kill and animal movements will continue before and after the project to determine its effectiveness.

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# Relationships Among Black Bears, Roads, and Habitat in the North Cascades Mountains

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We studied the effects of roads on black bear habitat use at two studies areas using radio-telemetry from 1995-1998. One study area was located on the west side of the mountains where moisture was greater, and the other study area was located on the drier east side. The influences of roads on habitats were evaluated using compositional analysis and logistic regression to derive resource selection functions (RSFs). Roads influenced den site selection and habitat use. At both study areas high open roads densities were consistently ranked as low use. Roads reduced habitat effectiveness during all seasons at both study areas and changes in potential habitat values ranged from 1.7-16.9%. We used scaled RSFs in a habitat-based population model to assess the influences of roads on potential black bear population sizes. On the west-side study area the potential black bear population size was most influenced by moderate use roads during the early season. On the east side low use roads had the greatest influence during the early season.

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# Nest Site Characteristics and Nesting Success of Cooper's Hawks at Fuels Reduction and Fire Effects Research Sites Along the Middle Rio Grande, New Mexico

JUNE M. GALLOWAY[1]

Since 2001, the Rocky Mountain Research Station has monitored avian populations along the Middle Rio Grande in New Mexico as part of a fuels reduction and fire effects research study. Sampling included point count surveys and intensive nest monitoring. From 2001-2004, Cooper's hawk (*Accipiter cooperii*) nests (n=30) were monitored and accompanying nest habitat data were recorded. Surveys were carried out at 17 homogeneous riparian ('bosque') areas along the Middle Rio Grande watershed during the main breeding season (15 May-15 August). Research areas were either sites where fuels reductions were scheduled to take place or had already taken place, or sites where wildfire had occurred. Along the Rio Grande bosque, Cooper's hawks appear to nest exclusively in the deciduous species, Rio Grande cottonwood (*Populus deltoides* var. *fremontii)*. Nest tree height, nest height, and nest tree diameter at breast height were consistent across all research sites, with Cooper's hawks nesting only in mature trees. Cooper's hawks had a high rate of nesting success (~86%) and nest site reuse during successive years was recorded. Levels of human disturbance from fuels removal and site treatment activities do not appear to adversely effect nesting Cooper's hawks. Possible response to wildfire events has yet to be determined, due to lack of sufficient data sets.

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# Puma Ecology and Movements in the Grand Canyon Region, Arizona, USA

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Although pumas (*Puma concolor*) are present throughout Grand Canyon National Park, little is known about their movements and ecology in the Park and adjacent areas. We present initial data from a three-year puma monitoring study in Grand Canyon National Park in northern Arizona. We document movement patterns of pumas using portions of the National Park and adjacent public lands. The objectives of this study are: 1) to examine puma movements and habitat use in a highly variable topographic landscape; 2) to document puma use of areas with high human activity; and 3) to document puma prey selection. To date two male pumas have been captured and monitored in and around the South Rim of the Grand Canyon. Pumas are tracked daily via GPS and VHF transmitters and their movements mapped using GIS. Results will be applied toward Park planning, land protection, and management in the Grand Canyon eco-region. Information from this study will be incorporated into Park education and outreach programs to increase public understanding of puma ecology and movements.

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# Description of the Dwarfed Cozumel Island Fox Based on Analyses of Subfossil Bones

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A dwarf population of gray fox (*Urocyon cinereoargenteus*) has existed on Cozumel Island, Mexico, for at least 1500 years, but no formal taxonomic descriptions or morphological assessments of the animal have been made. Recent field study has indicated that the fox is on the verge of extinction. Given the imminent threat to the persistence of this population, it is critical to assess any available materials and, if justified, describe the population in a taxonomic framework. Because there are no specimens of the Cozumel fox available in museum collections, we examined the size of the fox based on specimens collected during archaeological excavations throughout the island. These specimens derive from the feeding middens of Mayan peoples who inhabited the island ca 1500-500 ybp. Measurements of 38 bones from a minimum of 7 adult individuals obtained from 4 sites across the island suggest that this animal was already dwarfed (body size was ca 65%-70% of mainland specimens) during the period that Mayans inhabited the island. These measures are similar to those of Cozumel Island Carnivora which are recognized as distinct species. We suggest that the Cozumel Island gray fox similarly deserves species-level designation.

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# Arizona Game & Fish Department's Black-footed Ferret Reintroduction Project

C. Zoe Hackl[1], Tiffany Volz[1], Kristen Hoss[1] and Laura Smith[1]

The primary goal of the Arizona reintroduction effort is to establish a free-ranging, self-sustaining population of black-footed ferrets (*Mustela nigripes*) into the Aubrey Valley Experimental Population Area (AVEPA) without negatively impacting local lifestyles. To do this, our focus has been on pre-conditioning release candidates and on developing on-site breeding protocols that will contribute to national recovery efforts.

Aubrey Valley is composed entirely of tribal, state and private land. AVEPA is also located within a working cattle ranch. A multiple-party work group is in place to discuss management options for the AVEPA and to resolve any disputes that may occur. Arizona Game and Fish Department's partners include: the Hualapai Nation, Arizona State Land Department, the Navajo Nation, Cholla Cattle Company, and the Phoenix Zoo.

Arizona was the first project to develop and evaluate on-site acclimation pens for pre-conditioning of release candidates; all ferrets in the national program must now be pre-conditioned prior to release. In 1998, Arizona became the first state to successfully breed ferrets in pre-conditioning pens. In 2001, Arizona became the first to experiment with spring releases of pregnant females and has successfully continued this practice. Evidence of whelping in the wild was found following these releases.

This poster, developed by the Black-footed Ferret Reintroduction Team discusses the projects success from 1996-2004. It covers a description of the recovery area, prairie dog numbers, ferret monitoring, and a current ferret population status.

As of 2004, only one site in the US is considered sustainable (Conata Basin, South Dakota). Arizona is considering initiating a second reintroduction site.

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# Establishing Priority Sites for Conservation: Can Core Areas be Used to Address Habitat Concerns for Badgers in Western Canada?

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Defining "critical" habitat for species at risk may be one of the keys to effective conservation planning, but this can be challenging for animals that maintain large home ranges and have general habitat requirements. Identifying areas that are used more intensively (core areas) within a home range could help to locate important resources and priority habitat for conservation. We studied the spatial ecology of 13 radio-tagged badgers (*Taxidea taxus jeffersonii*) in an endangered population in British Columbia, Canada. For 8 badgers (7M, 1F), we determined home ranges (95% fixed kernel analysis), identified core areas and habitat selected within core areas. Badgers used large home ranges that encompassed 15.6 $km^2$ to 53.7 $km^2$ (95% fixed kernel). Five animals exhibited significant use of core areas ($P < 0.10$) that consisted of 2 to 5 patches and covered between 21% and 33% of each home range area. Each badger selected for unique habitat features inside of core areas located in grasslands, fields, clearcuts and dense forest, and no strong correlation of burrow locations with respect to soil characteristics and prey sign were found. We believe that our difficulty in identifying so-called "critical" habitats resulted from the fact that, although these animals showed specialized traits and behavior for excavating prey and burrows, they were able to exploit many different types of habitats using their particular adaptations. Therefore, the conservation or management plan for these animals cannot hinge on identifying "critical" habitat alone, but must address a more comprehensive suite of issues.

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# Collaborating on Tangible Projects to Prevent Human-Grizzly Bear Conflicts

MINETTE JOHNSON[1]

Increasing populations of grizzly bears creates a greater likelihood of conflict between bears and humans and, frequently results in bear mortality. This situation provides an excellent opportunity for conservation groups to collaborate with federal, state, tribal officials, corporations and private landowners to implement programs on the ground to prevent conflicts and reduce mortalities. Defenders of Wildlife has been engaged in such collaborative projects for several years. In addition to paying compensation for verified livestock losses to grizzly bears, Defenders of Wildlife has worked with bear managers and private landowners to cost share on thirty-two projects throughout the Northern Rockies. The objectives of these projects are to increase tolerance for grizzly bears and to reduce the likelihood of bears being relocated or removed from the ecosystem. Specific projects include: paying compensation for verified livestock losses to grizzly bears; constructing electric fences around calving grounds or sheep bedding grounds to protect livestock when they are most vulnerable; buying bear-resistant dumpsters for communities, campsites and recreation areas to prevent bears from becoming habituated to garbage as well as coming into close proximity of people; erecting permanent electric fences around beeyards with a history of being damaged by bears; commissioning evaluations of grizzly bear recovery zones to identify attractant problem areas; and creating educational materials to provide guidance to residents on simple steps they can take to reduce their chances of having problems with bears. Reducing human-caused mortality and building local acceptance of grizzly bears are key to making progress on grizzly bear recovery and occupation of currently vacant habitats. Conservation groups can encourage grizzly bear recovery by building partnerships with agencies, landowners and other groups to prevent bear/human conflicts before they occur. Too often the relationship between conservation groups and agencies is based on confrontation rather than collaboration. This project provides an example of a direction more likely to benefit bears through cooperation instead.

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# Graph-Theoretic Modeling of Functional Habitat Connectivity for Lynx on the Okanogan Highlands, Northern Washington*

AARON JONES[1] AND RICHARD ASPINALL[2]

Maintenance of habitat connectivity over various geographic scales is a conservation imperative for the long-term persistence of many species, including peripheral, southern populations of Canadian lynx (*Lynx canadensis*). Multi-scale analysis of functional connectivity in landscape structure can help to better inform this conservation concern. Using topographic and landcover classifications as predictor datasets, combined with radiotelemetry data collected during two previous studies in the Okanogan National Forest, Washington, lynx habitat selection is analyzed at two biologically-based spatial scales. Significant habitat associations are identified using Chi-squared tests, Neu's method, and compositional analysis. These associations are used to create probability models for lynx presence using Bayes theorem. This provides an index of habitat suitability, and also allows for both the objective delineation of habitat patches and data-driven generation of a cost-surface for lynx movement in the study landscape. Patches and cost-weighted inter-patch distances are converted to lattice data structures (graphs) that are used as analytical frameworks in assessing functional connectivity as it relates to the potential prioritization of areas for lynx habitat protection. Specifically: (1) inter-patch linkages most critical to the preservation of broad- and fine-scale connectivity are identified; (2) patch networks forming the parsimonious "backbones" of connectivity are determined; and, (3) the sensitivity of both indices to patch definition criteria is assessed. Because the pairing of Bayesian and graph-theoretic techniques maintains a species-centric view of the landscape and can yield meaningful conservation insights even withrelatively few data, the approach may be well-suited for modeling connectivity of habitat for other far-ranging carnivores.

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# Pumas in the West: Heading Towards Overkill?

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Mountain lions (*Puma concolor*) require expansive habitats because they are an obligate carnivore and their food supply is dispersed over long distances. A male puma requires at least 100 square miles of habitat. Pumas, a top-level carnivore, are also a keystone species because they have a major impact on community structure.

A female cat spends approximately 70 percent of her lifetime raising young. Born year-round but with births peaking in the summer and fall months, kittens are totally dependent upon their mothers for their first nine months, and typically spend between eleven and sixteen months with their mother.

Sport-hunting seasons in the West occur in the fall and winter, during or right after pumas' peak birth pulse. Across the West, between 40 and 50 percent females comprise the total hunter kill. Thus, if a hunter kills a female with dependent young, he is in fact, killing 3 to 4 pumas.

Sinapu recently published a study of puma hunting in twelve western states. Over the past two decades, sport hunters have more than doubled the number of pumas killed across the West (in 1982, hunters killed approximately 850 pumas in 10 western states, 2,244 in 1992, and 3,129 in 2002). In addition, pumas are fast losing habitat, connected habitat, and their prey base. We argue that wildlife agencies need to drastically change current puma management or possibly risk extirpation of some subpopulations.

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# Assessing Grizzly Bear Population Status at an Ecosystem Scale

KATE C. KENDALL[1] AND JEFF B. STETZ[2]

We describe preliminary results from a 2004 study to estimate the size of the grizzly bear (*Ursus arctos*) population from hair samples found on 31,400 km$^2$ (7,750,000 acres) in northwestern Montana. Microsatellite analysis of the hair is used to identify individual bears for use in a mark-recapture population model. We employed two methods concurrently to sample bear hair. Using a 7x7 km grid to systematically sample the study area, we collected hair from 2,560 baited hair snag stations. The second approach used repeated hair collection visits to a network of 4,950 bear rub trees, sign and fence posts, and power poles along trails and roads. No attractant was used on rub objects. During four 14-day capture sessions, 20,650 hair samples were collected from baited sites. Collections from rub objects yielded approximately 13,000 hair samples. Extensive fieldwork and logistical planning were required the previous year to prepare for the sampling effort. Quality assurance staff worked with field crews to ensure consistent application of field protocols. We describe strategies for working at large scale, such as: 1) methods of coordinating activities among the federal, state, tribal, and private entities involved with an ecosystem scale project, and 2) multiple procedures to be used during data collection and genetic analysis to prevent, detect, and correct errors. We also discuss the challenges of, and recommendations for directing 200 widely dispersed field employees and conducting fieldwork on extensive tracts of private property and in remote areas where communication with crews is limited.

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# Opportunities for Passive Collection of Bear Hair

KATE C. KENDALL[1], JEFF B. STETZ[2] AND AMY C. MACLEOD[2]

In contrast to studies using baited hair snag stations, we surveyed trails, roads, power lines, and fences on 31,400 km$^2$ in northwestern Montana to identify trees and other objects with bear hair deposited through natural rubbing behavior. Genetic analysis of hair is used to identify individual grizzly bears (*Ursus arctos*) and black bears (*U. americanus*) to document presence, obtain minimum counts, and for mark-recapture population estimates. Over 13,000 hair samples were collected from wire attached to the rub surface. Samples from barbed wire had more follicles and required less time to collect than hair deposited on trees, and helped define discrete samples from individuals. Of 4,700 rub objects identified, 85% were trees along 7,500 km of hiking trails on public lands. Bears also rubbed on sign and fence posts and power poles. Bears rubbed on 16 tree species with a mean diameter of 28.7 cm (range = 3.2-176.3 cm). Most rub objects were inconspicuous but 67% had bear bite or claw marks and 29% had bear trails leading to them. The density of rub trees along forested trails varied but it was rare to find areas devoid of rubbing activity. Due to high levels of pack animal use in some areas, 13% of rub trees were bumped by stock. Because barbed wire may cut horses or their packs, we report on the effectiveness of alternate hair grabbers. Collecting hair from rub trees can be an efficient way to sample bear populations and detect individuals not found at baited sites.

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# Evaluation of Intraspecific Cross-Fostering Among Canids as a Potential Conservation and Research Tool

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Cross-fostering has been attempted opportunistically with endangered canids as a means of increasing populations using pups that have lost their natal parents or were bred in captivity. However, the overall likelihood of success and the factors that might influence success of this procedure are unknown. Due to the potential usefulness of cross-fostering to conservation efforts and as a research tool, a better understanding of factors influencing success rates is essential. Using captive coyotes (*Canis latrans*) as a model, we assessed the willingness of female canids to foster young born to another mother. We assessed the efficacy of two procedures: fostering pups into existing litters (augmentation), and completely switching litters (replacement). We augmented four litters with two pups of similar age when pups were less than seven days old. In addition, we replaced four entire litters when pups were less than ten days old. We also attempted augmentations with pups 3-4 and 6-7 weeks of age. Survival and weight gain of all pups were monitored for six weeks and compared to that of four control litters to assess overall success of procedures. We also made observations to assess the effects of fostering on 6-week dominance status of pups. All complete litter replacements were successful, with survival rates among switched litters similar to those of control litters. For augmented litters, survival was dependent on the age at which fostering occurred. All pups fostered into litters before the age of one week survived until the end of the sampling period, one of three fostering attempts with three week old pups failed, and two attempts to foster six-week-old pups failed. If they survived, fostered pups appeared to be at no disadvantage. Weight gains were similar for pups in all treatments, and there was no evidence of reduced dominance status among fostered pups as compared to the natal pups in the same litters. These results illustrate factors that might affect the success of attempts to cross-foster canid pups in the wild.

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# Feasibility Assessment for Reintroducing Fishers to Washington

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Historical over-trapping, loss and fragmentation of low to mid-elevation late-successional forests (i.e., suitable habitat), predator and pest control campaigns, and incidental capture were the main causes of decline of the fisher (*Martes pennanti*) population in Washington. Protection from trapping since 1934 has not resulted in the recovery of the population, which is now extirpated in Washington. Similar declines occurred throughout the fisher's range in North America. Reintroductions have re-established fishers throughout much of their range. In 2002, a feasibility study was initiated to determine if a fisher reintroduction could be successful in Washington. A science team was assembled to design the study and provide oversight. A habitat assessment investigated the amount and distribution of suitable habitat, its connectivity via travel cover, and ability of large blocks of connected suitable habitat to support fisher populations. A genetics study evaluated the suitability of fishers throughout their range for reintroduction in Washington. A literature review evaluated the suitability of the existing prey base for a reintroduced population. The Olympic Peninsula was identified as the most suitable fisher reintroduction area based on amounts of suitable habitat and estimated carrying capacity. Fishers from British Columbia, California and Alberta are suitable for reintroduction; however, fishers are available only from Alberta and possibly from British Columbia. An adequate prey base exists for a reintroduced population. Legal aspects, potential reintroduction scenarios, and potential stakeholders and cooperators were also investigated. A successful reintroduction appears feasible and a NEPA analysis for a proposed reintroduction on the Olympic Peninsula is being initiated.

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# Behavioral Response of Captive Wolves to Close-Range Vocalizations: An Experimental Test of Motivation-Structural Rules*

WILLIAM E. LOFTIS[1] AND JENNIFER A. CLARKE[1]

The history of wolf (*Canis lupus*)-human conflicts in North America has been well documented. Historically , humans have used lethal control methods against wolves including bounty systems, trapping, poisoning, and aerial or land-and-shoot hunting. Recent recolonization and reintroduction of wolves to several states has caused an increase in the number of livestock depredations, as well as the need for effective control measures. Due to recent changes in the public's perception of wolves, lethal control measures are largely viewed as inhumane. Management agencies have attempted to create non-lethal control methods, such as fladry, radio activated guard (R.A.G.) devices, and relocation of "problem" wolves/packs. These methods have had limited success. Morton (1977) analyzed the relationship between acoustic structure and motivation of vocalizations and proposed motivation-structural rules. In many bird and mammal species, "friendly" vocalizations tend to be higher frequency, narrow bandwidth sounds (indicating a small animal), while "hostile" vocalizations tend to be lower frequency, wider bandwidth sounds (indicating a large animal). While this general relationship seems apparent, the behavioral response of the receiver of the vocalization has never been experimentally tested. I am testing motivation-structural rules by observing the behavioral responses of captive wolves to experimental playbacks of natural "hostile" vocalizations and artificially lowered "hostile" vocalizations. If motivation-structural rules hold true, wolves should avoid artificially lowered "hostile" vocalizations more than natural vocalizations. Used in conjunction with audio broadcast devices (R.A.G devices), artificial vocalizations could possibly be effective as a wolf deterrence method.

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# Effectiveness of the Track Plate Method to Monitor American Marten on the Wenatchee National Forest, Washington*

DANIELLE R. MUNZING[1] AND WILLIAM L. GAINES[1]

This project is a pilot study that examines the effectiveness of the track plate technique on American marten (*Martes americana*) detection rates in areas of Late Successional Reserve (LSR) on the Wenatchee National Forest located in the North Cascades of Washington. Track plate techniques were used following the protocol of Zielinski and Kucera (1995) to detect American marten in dry and moist forest habitats within LSRs. In addition the study attempts to examine the diversity and index of abundance of small mammal species at track plate stations. Results thus far indicate a marten detection rate in 2003 of 0.033 per trap night (180 trap nights) and 0.083 per trap night in 2004 (60 trap nights) with an overall detection rate of 0.046 per trap night in the moist habitat types. Marten were undetected at dry sites (156 trap nights). The results of this study will provide information to wildlife managers about the efficiency of using the track plate technique in long term monitoring studies for marten.

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# Using GPS-Telemetry to Discern Movement Patterns of Reintroduced California Condors in Central and Southern California

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Due to logistical constraints of fixed-wing VHF-telemetry searches and ground-based efforts, our current knowledge of California condor (*Gymnogyps californianus*) movement and habitat use may be limited, and biased towards areas in close proximity of release sites. Location estimates yielded by satellite-monitored transmitters only assist in this regard marginally. These constraints hinder our ability to assess potential threats and habitat requirements of the species beyond release sites. Understanding these current monitoring limitations, 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. We found significant differences with respect to the accuracy and frequency of the locations yielded by the transceivers ($P = 0.000$) and ($P = 0.001$) respectively, with average distances from known locations ranging between 10.1 and 23.6 m and the average number of location fixes yielded per day ranging between 10.0 and 13.5 out of 16 possible. While there seems to be variation in the performance among individual transceivers, accuracy and frequency results are very encouraging. Additionally, these GPS units provide heading, elevation and speed data not previously available allowing us to better assess activity patterns. Supplemental feeding at release sites appears to influence movements of reintroduced condors; however, long-distance flights from these sites are common. GPS-telemetry may provide a dramatic improvement in our ability to accurately discern flyways, perch and roost sites, foraging locations, and fatalities of California condors, further improving our conservation management strategies for the species.

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# Effects of Roads on Asiatic Leopard Abundance in Kaeng Krachan National Park*

DUSIT NGOPRASERT[1], GEORGE A. GALE[2] AND ANTHONY J. LYNAM[1]

Roads and other forms of human disturbance can negatively impact the survival and behavior of a variety of large carnivores. To determine whether such factors, in addition to biophysical factors and prey abundance, influence the abundance and distribution of Asiatic leopards (*Panthera pardus*), camera-trapping techniques and capture-recapture estimation models were used for a study in Kaeng Krachan National Park, central Thailand. Density of leopards was 4.78 ±2.42 individuals per 100 km$^2$, or a minimum of 4 males and 2 females known alive in the 104 km$^2$ study area. The activity patterns of the leopards indicated substantial individual variation, some individuals being relatively diurnal while others appeared to be more nocturnal. A logistic regression model suggested leopard relative abundance was significantly lower near the road that bisected the study area ($R = 0.28$, $df = 1$, $p = 0.002$), while abundance was significantly higher near water ($R = -0.20$, $df = 1$, $p = 0.016$). Although illegal hunting is probably impacting leopards, human traffic in the forest by itself did not appear to significantly affect abundance, although more study is needed to confirm this. There also seemed to be seasonal changes in which distance to water sources was more important during the dry season, while prey abundance appeared to be more closely related to leopard abundance during the rainy season. In addition to more effort needed to reduce poaching, more research is needed to determine the demographic implications of road avoidance for such species, and what if any mitigation strategies are required.

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# Long-Distance Communication in African Wild Dogs: Detection Avoidance

ROBERT L. ROBBINS[1] AND E. KIM MCCREERY[1]

A number of species are known to minimize vocalizations to avoid detection by competitors and predators. In closed habitats, visual contact is impaired, which poses special challenges both for those risking detection and for those potentially benefiting from such discoveries. In group-living and highly mobile carnivores like the African wild dog (*Lycaon pictus*) pack members are frequently separated during hunts. When this occurs, long distance contact calls known as "hoos" are sometimes given to facilitate reassembly. Such calls, however, risk attracting competitors like spotted hyenas (*Crocuta crocuta*) attempting to kleptoparasitize kills. Acoustic communication was studied during a nine year wild dog project in Hwange National Park, Zimbabwe. Ninety two percent of the park is bushland and woodland. We hypothesized that one strategy used by hyenas to locate wild dogs was to eavesdrop on hoo calls. Using hoo playbacks, 30 trials were conducted at 13 calling stations. Hyenas (n = 15) approached calling stations in 27% of trials. Given that hyenas were attracted to these calls, the patterning of long distance vocalizations may reflect a compromise between minimizing detection and facilitating pack cohesion. Hoo calling was heard during 34.4% of wild dog hunts (n = 108). Analysis of call and reply frequencies, and syllable and bout lengths, coupled with a suite of non-vocal behavioral strategies used to reassemble pack members, suggest that wild dogs minimize the risk of detection.

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# Seminal Characteristics of Wild Black-Footed Ferrets

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Recently, a significant decline in semen quality has been observed in captive black-footed ferrets (*Mustela migripes*) with % normal sperm (NS) and intact acrosomes (IA) decreasing from 52 to 22% and 90 to 74%, respectively. Our objective was to assess semen traits in wild-born black-footed ferrets at reintroduction sites during a Biomedical Survey in 2003 and 2004 for comparison to the captive population. Electroejaculates were assessed for sperm concentration (x106 sperm/ml), % NS and % IA. A total of 33 wild males was evaluated at Conata Basin, SD (CB; n = 21); Cheyenne River Sioux Tribal land, SD (CRST; n = 5); Charles Russell National Wildlife Refuge, MT (CMR; n = 2); and Shirley Basin, WY (SB; n = 5) for comparison to 84 captive-born males. Mean (± S.E.M.) sperm concentration was lower ($P < 0.01$) in SB (65.0 ± 25.4 x106 sperm/ml) than CRST (1,375.4 ± 279.2) and CB (970.9 ± 118.9) ferrets, but was similar ($P > 0.05$) to CMR (771.7 ± 279.7) and captive males (419.6 ± 39.0). Mean NS was similar ($P > 0.05$) among all wild-born populations (37.8 ± 2.9%; range, 32 to 46%), and only SB males produced a higher ($P < 0.05$) proportion of NS (46.4 ± 8.5%) than captive males (22.2 ± 1.6%). Mean IA was similar among all wild-born (81.0 ± 2.5%; range, 76 to 90%) and captive-born males (74.2 ± 1.9%). These results demonstrate that semen traits vary among black-footed ferret populations, and further study is needed to determine etiology.

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# Observations of Compliance to the Voluntary Quarter Mile No-Boat Zone Along San Juan Island, Washington State, USA, From an Independent Killer Whale Tracking Study, 1999-2001

JODI C. SMITH[1]

In 1999 the Whale Watch Operators Association Northwest modified and included a further guideline within their "Best Practices Guidelines" on the recommendation of local researchers and not for profit groups. The voluntary "quarter-mile no-boat zone" guideline was instituted along San Juan Island to limit traffic surrounding whales when they were within one-quarter mile of the shoreline. All whale watching vessels were asked to stay on the offshore side of the animals, one-quarter mile or 440 yards from shore and not to block the path of traveling whales. This guideline also gave land-based whale watchers an unobstructed view to the whales passing along designated viewing areas. Coincidently, in the same year an independent theodolite vessel impact study was set-up on San Juan Island to assess any potential impacts boats might have on the local killer whale pods. The high vantage point of the study site and the ability to mark and track in real time the positions of both killer whales and vessels in relation to the shoreline allowed for the observation and report of compliance with the "quarter-mile no-boat zone."

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# The Effects of Novelty and Natural Versus Artificial Enrichment on Slender-Tailed Meerkats During Foraging*

ELLEN M. STRINGER[1]

Species evolutionarily designed for explorative foraging tend to be more neophilic than neophobic when encountering novel stimuli. I investigated foraging latencies in response to novelty and concealed food in captive slender-tailed meerkats (*Suricata suricatta*) at the Dallas Zoo in Dallas, Texas. Six novel foods were presented in addition to two concealed foraging conditions (natural, artificial). Latencies to approach and consume in all treatments were timed for each individual. Consumption latencies in both the natural and artificial foraging conditions were significantly different when compared to a familiar foraging regime. Over time, there was a decrease in latencies to find food in the concealed conditions as the meerkats became familiar with where food was located. Differences in consumption latencies between the two experimental concealed conditions were significant on first exposure only. Approach and consumption latencies of novel foods were significantly longer than that of familiar food. Confounding factors during data collection influenced approach latencies. However, differences in consumption latencies of novel vs. familiar food were highly significant and results suggest these differences were due to novelty. Additionally, caloric content of novel food items may have influenced number of individuals willing to consume, the amount consumed, and the number of aggressive moves made against conspecifics for each food item. Overall results suggest that captive meerkats exhibit guarded neophilia, as expected due to their explorative foraging style, in response to novel food.

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# Wildlife Monitoring on Decommissioned Roads in the Clearwater National Forest

**T. A. Switalski[1], Katherine Court[2] and Susan E. Townsend[3]**

Over the past century, more than a half million miles of roads have been built on public land to facilitate resource extraction, recreation, and transportation. Wildland roads influence carnivores through direct habitat loss, fragmentation, and associated human impacts. Road decommissioning has become an increasingly common restoration technique on Forest Service lands to mitigate the impacts of their aging road system. Scientists have found that road decommissioning decreases chronic sediment loss on roads and reduces the risk of road-triggered landslides, thus improving aquatic habitat. However, no research has yet directly quantified the impacts on terrestrial wildlife. We have started a pilot study to identify if wildlife are using decommissioned roads. The Clearwater National Forest and the Nez Perce Tribe maintain an active road decommissioning program in the Upper Lochsa River Basin, ID with an average of 40 miles each year. We have established wildlife monitoring sites on decommissioned roads with control sites along existing roads. Methods for monitoring wildlife include camera stations, track plates, and transects. While only in the first year of this pilot project, we have already documented the use of decommissioned roads by wolves, bears, and ungulate species. Over time, we will gain a better understanding of the effects of road decommissioning on species composition and abundance.

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# Kinship Recognition Among Coyotes Using Olfactory Cues

JESSICA L. TEGT[1], WILLIAM C. PITT[2], ERIC M. GESE[3] AND FREDERICK F. KNOWLTON[3]

The effects of scent on canid behavior and canid olfactory abilities are well accepted, although data regarding information contained in olfactory cues is meager. Hypotheses suggest odors associated with fecal, urinary, and anal gland secretions serve as "signatures," potentially conveying information about sex, age, health, and social status of the source animal. Other hypotheses suggest they also convey information about kinship and pass on information relevant to group membership or mate selection. We investigated whether coyotes (*Canis latrans)*, provided with only odor cues contained in feces, urine, anal gland secretions, or blood serum, could discriminate among kinship relationships. Based upon the amount of time spent investigating samples from animals with varying degrees of relatedness, we conclude coyotes can readily discriminate between individuals with familial ties and totally unrelated animals among all sample substrates. Furthermore, with urine and serum samples, they could also discriminate their degree of relatedness to the donors from which the samples originated. Discriminating relatedness on the basis of odors associated with serum, and absent the microbial activity typically associated with feces and anal gland secretions, suggests the process is basic in origin and possibly related to the major histocompatability complex (MHC), a set of uniquely coded genes in the immune system. Whether coyotes recognize "self," or detect differences from self remains to be examined, as well as whether they recognize individuals on the basis of various body odors. Future research should assess if a coyote's investigatory time is related to "interest" or effort needed to interpret the cues.

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# Predicting distribution of the Indian Fox using Ecological Niche Modeling

ABI TAMIN VANAK[1] AND MOHAMMED IRFAN ULLAH[2]

The Indian fox (*Vulpes bengalensis*), a canid endemic to the Indian subcontinent, is categorized as being "Data Deficient" by the IUCN's Canid Specialist Group. Recent surveys have indicated that the distribution of this species might be widespread, but it seems to occur at highest densities in semi-arid short grasslands. We used survey data from two states in southern India to predict the distribution of the Indian fox in un-surveyed areas using ecological niche modeling. We used 32 predictor variables obtained from various sources at a 1km x 1km resolution. This data was analyzed using Desktop GARP to predict the ecological niche of the Indian fox. Using 76 occurrence records from survey data, 50% were randomly selected for modeling and the remaining points were used for accuracy assessment. Out of a total of 40 models produced by the software, we selected the best 15 and found the predictive accuracy of these models to be greater than 89%. We merged the 15 models using a GIS, and the regions predicted by more than 50% of the best models were considered to be high density Indian fox habitat, while the rest were low density fox habitat. We believe that a very small proportion of this predicted high density habitat falls within protected areas. We suggest that this kind of predictive habitat modeling be used by conservation planners to identify crucial habitats for the protection of the Indian fox.

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# Preliminary Results from a Captive Eastern Coyote Study

JONATHAN G. WAY[1]

In this presentation, I will describe the experience and process of raising five wild-born eastern coyotes that were removed from their natal den (under a shed) in suburban Cape Cod at 3 1/2 weeks of age. I will discuss the transition from a study of coyote ecology in the wild to a captive pup study. The advantages of both types of complementary studies will be discussed. Specifically, in this presentation I will describe the ethics of a captive pup study and will detail how the pups were obtained. I will then discuss the transition from raising and nursing them at home (up to 8 weeks of age) to the move to their final destination: The Stone Zoo. Finally, I will explain preliminary results from this project, including a description of the socialization process and the development of an ethogram (behavior repertoire) on this group of coyotes. Collaborative partnerships, between local area high schools and the coyote research team, will also be discussed. For more information on coyotes, please visit my Eastern Coyote Homepage website at http://www2.bc.edu/~wayjo.

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# Using Remote Video Technology and Web-Based Images of Alaskan Brown Bears to Educate the Public in Science and Science Research*

SARAH A. WEBER[1], LAWRENCE R. GRIFFING[1], PAULINE CASTILLO[1], LAUREN DENGLE[1] AND ANASTACIO SAENZ[1]

The brown bears (*Ursus arctos*) that aggregate during salmon runs at the falls in McNeil River State Game Sanctuary have been studied by scientists and viewed by the public for more than three decades. Bear behavior at the falls continues to excite scientific and public interest. Remote video was first introduced for ecotourism, providing many more people (visitation to the falls is based on a lottery system) a window on the bears through local museums (Pratt Museum, Homer, AK) and the web site of National Geographic. In the summers of 2002 and 2004, web-based remote cameras were operated by the Griffing lab research team in the NSF-sponsored Information Technology in Science (ITS) Center for Teaching and Learning at Texas A&M University. The objective of the project is to improve public understanding of science by providing several avenues for engaging students, teachers, and the public in the process of science. Research findings include (1) students watching the videos with a question in mind develop higher levels of critical thinking, (2) many of the bears can be positively identified through individual markings and image analysis, (3) bears tolerate closer proximity in certain regions, not necessarily regions of highest fishing success, and (4) females with cubs-of-the-year avoid regions of high density and times of high occupancy at the falls. Future work will include further scientific analysis of bear behavior at the falls, the development of a web site through which our data can be accessed, and informal science education at local, national, and international museum venues.

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# A Comparative Study of Spectacled Caiman and Dwarf Caiman

JENNIFER M. WHITE[1] AND JESUS A. RIVAS[2]

The spectacled caiman (*Caiman crocodilus*) and dwarf caiman (*Paleosuchus trigonatus*) reside throughout much of the tropical South America. While the spectacled caiman is a habitat generalist, the dwarf caiman is habitat specific to small forest streams, terrestrial retreats, and cooler higher altitude ranges. When adult dwarf caimans migrate from the forest streams to major rivers in search of food, we hypothesize that there will be a significant difference in the selected habitat between the two species along the river bank. Juvenile behavior and diet of the two species was also expected to be different due to the difference of nesting habitat. A series of night surveys along Rio Tiputini revealed a significant difference in vegetative cover used by the two species, with dwarf caimans selecting low vegetative cover. Overnight observations were made on juvenile dwarf caimans in a forest stream to determine previously unknown behavior of these juveniles. Dwarf juveniles spend much of their time partially submerged close to the bank of the stream and remain motionless. The spectacled caiman juveniles observed along the banks of the Tiputini were swimming and calling for protection. Differences in behavior were most likely due to age difference rather than species differences; however, the newly documented dwarf juvenile behavior offers a basis of comparison for future studies. There was a significant difference in the diet of the juveniles, reflecting opportunistic hunting in two different habitat types.

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