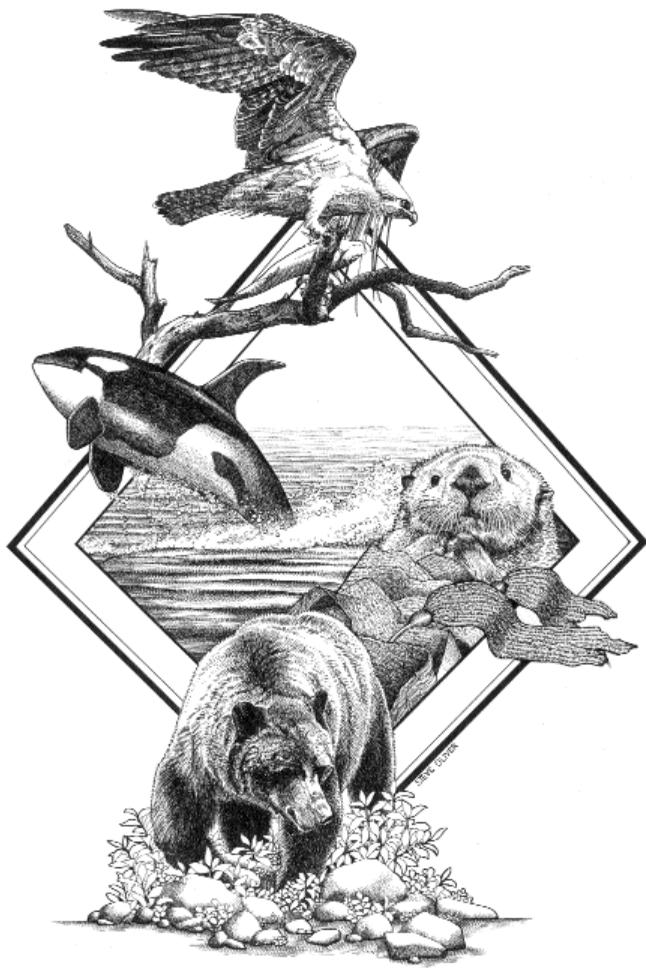


PROCEEDINGS and AGENDA



for Defenders of Wildlife's

CARNIVORES 2002



**From the Mountains to the Sea:
A Conference on Carnivore Biology and Conservation**

**November 17-20, 2002
Monterey, California**

Compiled by: Kate Davies, Aimee Delach, Liz Epstein, Mary Selden, Defenders of Wildlife

PRINTED ON RECYCLED PAPER

PREFACE

This volume contains the agenda and abstracts for Defenders of Wildlife's *Carnivores 2002—From the Mountains to the Sea: A Conference on Carnivore Biology and Conservation* held in Monterey, November 17-20, 2002. This is Defenders' fourth biannual conference, this time expanded to include marine carnivores.

Carnivores 2002 comes at a crucial time. Many species still face serious threats that inhibit conservation efforts. Gray wolves are confronted with the stark possibility of being reclassified and given reduced assistance under the Endangered Species Act. Such a move would hinder efforts to return wolves to suitable habitat in California, the southern Rockies and the northeastern United States. Grizzly bears are up against similar problems; Secretary of the Interior Gale Norton has indicated she plans to reject a citizen-run initiative to return grizzly bears to public land in the remote Bitterroot mountains of Idaho and Montana—yet she offers no alternative plan of her own. Throughout the nation, habitat fragmentation and an ever-increasing number of roads and highways have proven deadly for many carnivores—over a million animals are killed on our highways every day. Road kills have pushed some rare species such as the Florida panther and grizzly bear closer to extinction. It is clear that in some areas carnivores are losing out to habitat destruction and conflicts with human activities.

Marine life around the world is also in jeopardy. Southern sea otters had been recovering, but now their numbers are hovering precariously around 2,000. Reasons for the population decline are not entirely clear but appear to be related to disease, entrapment in fisheries gear, potential food limitations and habitat degradation. Whales also face many different kinds of dangers deep within the ocean. For instance, the Navy's low frequency active sonar harms whales by interrupting their communication with one another and interfering with navigation. Recent studies also have found that orcas are among the most contaminated marine mammals in the world. Pollution and chemical contamination make orcas more susceptible to disease and may cause reproductive difficulties.

Defenders is always eager to work with other conservation organizations, wildlife agencies and diverse stakeholders to protect wildlife. It has been 15 years since we first activated our wolf compensation fund which reimburses ranchers for livestock losses resulting from wolf predation. This program has aided wolf conservation efforts and recently inspired the creation of The Bailey Wildlife Foundation Proactive Carnivore Conservation Fund which develops and supports nonlethal, proactive wildlife management approaches that help predators coexist with landowners. Numerous ranchers have already expressed their appreciation of this program and its ability to help them better understand the predator's role in fragile ecosystems.

Predator conservation and recovery face numerous challenges. We hope that this conference will help scientists, educators and activists meet these challenges. We are grateful to the many participants who contributed their time and expertise to ensure the success of *Carnivores 2002*.

Rodger Schlickeisen
President, Defenders of Wildlife

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SCIENTIFIC ADVISORY COMMITTEE

Edward Bangs, U.S. Fish and Wildlife Service

Paul Beier, Northern Arizona State University

Richard Curnow, USDA Wildlife Services

Jim Davis

Jim Estes, USGS Santa Cruz Field Station

Gale Ford, Grizzly Discovery Center

Jack Grisham, AZA Canid TAG Chair

Frances Gulland, The Marine Mammal Center

Dan Harrison, University of Maine

Jim Harvey, Moss Landing Marine Laboratories, California State University

Dave Jessup, California Department of Fish and Game

Janet Mann, Georgetown University

David Maehr, University of Kentucky

Jill Mellen, AZA Field TAG Chair

Paul Paquet, University of Calgary

Mike Phillips, Turner Endangered Species Fund

Roger Powell, North Carolina State University

Bill Ruediger, U.S. Forest Service

Len Ruggiero, U.S. Forest Service

John Schoen, National Audubon Society

Diana Weinhardt, AZA Bear TAG Chair

Bernd Würsig, Texas A & M University

AGENDA

Saturday, November 16, 2002

7:30 p.m. - 10 p.m.

Movie Night (Ironwood Room)
(see "Conference Events" for details)

Sunday, November 17, 2002

8:30 a.m. - 7 p.m.

Registration (DeAnza Foyer)
Exhibitor Hall Setup (DeAnza III)
Speaker Prep Room Available (Redwood I)
Poster Presentation Setup (DeAnza Foyer)

9 a.m. - 4 p.m.

Big Sur field trip. Buses leave starting at 9 a.m.
(see "Conference Events" for details)

1 p.m. - 3 p.m.

Northern Rockies Wolf Meeting (Cottonwood Room)

2:30 p.m. - 6 p.m., Special Session, Ironwood Room

EDUCATION WORKSHOP

2:30 p.m. - 4 p.m.

Demonstration and Discussion of Defenders' Sea Otter Unit

4:30 p.m. - 6 p.m.

Wolf Education Roundtable

Moderator: Patrick Valentino, California Wolf Center
Panelists: Pam Troxell, Timber Wolf Alliance
Brian Eckert, Pennsylvania State University
Holly Jaycox, Wolf Park
Steve Wadlow, The Central Rockies Wolf Project

6:30 p.m. - 7:30 p.m.

Western Carnivores Meeting (Cottonwood Room)

7:30 p.m. - 9:30 p.m.

Icebreaker (Monterey Bay Aquarium)
(see "Conference Events" for details)

Monday, November 18, 2002

7:30 a.m. - 6 p.m.

Registration (DeAnza Foyer)
Speaker Prep Room Available (Redwood I)

8 a.m. - 9:30 a.m., Monterey Conference Center, Steinbeck Forum

PLENARY SESSION

Opening
Special Guest

Welcoming Remarks
Mark Shaffer, Defenders of Wildlife

Ecological Chain Reactions in Kelp Forest Ecosystems
James A. Estes, USGS Santa Cruz Field Station

George Rabb, Brookfield Zoo

8:30 a.m. - 5 p.m.
Exhibit Hall Open (DeAnza Ballroom III)

9:30 a.m. - 10 a.m.
Coffee Break/Poster Session Open (DeAnza Foyer)

10 a.m. - Noon, Concurrent Session A, Monterey Conference Center, Steinbeck Forum
MOUNTAIN LION CONSERVATION AND MANAGEMENT
Moderator: Lynn Sadler, Mountain Lion Foundation

Puma Management in Western North America: A 100-Year Retrospective
Steven Torres, California Department of Fish and Game
Heather Keough, Utah State University
Deanna Dawn, San Jose State University

Mystery, Myth and Legend: The Politics of Cougar Management in the New Millennium
Rick Hopkins, Live Oak Associates, Inc.

Panther Dispersal, Conservation and Recovery Planning
David Maehr, University of Kentucky
E. Darrell Land, Florida Fish and Wildlife Conservation Commission

*Student Presentation

AGENDA

*Mountain Lions and Endangered Bighorn Sheep:
Challenges to Resolving an Apparent Disequilibrium*
Christopher M. Papouchis, Mountain Lion Foundation
John Wehausen, UC White Mountain Research Station

Living With Lions: Predators and Livestock in East Africa
Laurence Frank, University of California-Berkeley
Mordecai Ogada, Mpala Research Center
Rosie Woodroffe, University of California-Davis

Perspectives on the Conservation and Management of Wild Pumas in Western North America
Kenneth Logan and Linda L. Swanson, Wildlife Health Center, University of California-Davis

10 a.m. - Noon, Concurrent Session B, DeAnza Ballroom I

HUMAN DIMENSIONS OF CARNIVORE MANAGEMENT
Moderator: Martin Nie, University of Montana

Top of the Food Chain: American Diet and Lifestyle Activism
Joel Helfrich and Sraddha Helfrich, University of Minnesota

Endangered Species Act Management of the Western Alaska Steller Sea Lion: Evolution of Interagency Consultation
*Jeremy Rusin, University of Washington

State Wildlife Policy and Management: The Scope and Bias of Political Conflict
Martin Nie, University of Montana

Attitudes, Knowledge and Education of Residents Toward Mammalian Carnivores Along the Urban-Wildland Interface in Southern California

*Shalene L. George and Kevin Crooks, University of Wisconsin-Madison

Large Carnivores and People in Western Wyoming—Where is the Balance?

*Jason Wilmot, Karen Murray, Greg McLaughlin, Lyn Munno and Dylan Taylor, Yale University

Large Carnivore Preservation and Visitor Safety in National Parks: A Balancing Act Through DNA Analysis

Elaine Leslie, Emily Garding, Sarah Reed and Melanie Culver, National Park Service

10 a.m. - Noon, Concurrent Session C, DeAnza

Ballroom II

WOLVERINES IN ALASKA, CANADA AND EUROPE
Moderator: Len Ruggiero, Rocky Mountain Research Station

Wolverine Habitat Use in a Multiple-Use Landscape Near Revelstoke, British Columbia
John Krebs and Ian Parfitt, Columbia Basin Fish and Wildlife Compensation Program

Distribution, Density and Harvest Management of Wolverines in British Columbia
Eric C. Lofroth and Mike Badry, BC Ministry of Water, Land and Air Protection

Wolverine Spatial Use Patterns and Habitat Selection in South-Central Alaska
Howard N. Golden and Kevin S. White, Alaska Department of Fish and Game

Population Ecology of Wolverines in Northwestern Alaska
Brad S. Shults, National Park Service
Kyran Kunkel, Turner Endangered Species Fund
Fredrik Dalerum, Stockholm University

Wolverine Habitat Use on the Central Barrens in the Northwest Territories, Canada
Robert Mulders, Government of Northwest Territories

The Role of Infanticide and Reproductive Costs in the Population Dynamics of Scandinavian Wolverines
Jens Persson, Swedish University of Agricultural Sciences

Wolverines in Europe: Status and Conservation Challenges
Arild Landa, Norwegian Institute for Nature Research

10:30 a.m. - 11:30 a.m.

Ambassador Wolf Session I - by reservation only (Redwood II)

Noon - 1:30 p.m.

Lunch Break

AGENDA

**12:15 p.m. - 1:15 p.m., Lunchtime Session,
Monterey Conference Center, Steinbeck Forum**
**CARNIVORE CARAVANS: THE LAW AND POLITICS OF
TRANSPORTING PROTECTED SPECIES**

Moderator: Donald C. Baur, Perkins Coie LLP

Species Translocation: Legal and Political Questions
Donald C. Baur, Perkins Coie LLP

*The Endangered Species Act: Legal Context for
Transporting Protected Species*
Dale Goble, University of Idaho

Case Study: Translocation of Sea Otters
Donald B. Mooney, Law Offices of Donald B. Mooney

*Background on Section 10(j) of the Endangered Species
Act*
Margot Zallen, U.S. Department of the Interior

*Howling Success: A Recent Legal History of
Reintroducing Wolves to the Wild*
William J. Snape III, Defenders of Wildlife

12:15 - 1:15 p.m.

Press Lunch (Ironwood Room)

1:30 p.m. - 2:30 p.m.

**Ambassador Wolf Session II – by reservation only
(Redwood II)**

**1:30 p.m. - 3 p.m., Concurrent Session A,
Monterey Conference Center, Steinbeck Forum**
**MOUNTAIN LION CONSERVATION: MANAGING
CHANGE**

Moderator: Lynn Michelle Cullens, Mountain Lion Foundation

The Status of Mountain Lions in Yosemite National Park
Leslie Chow, USGS Yosemite Field Station

*Analysis of Harvest Strategies of Cougars in the Western
United States*

*Deanna Dawn, Michael Kutilek and Selekha Anand,
San Jose State University
Steve Torres, California Department of Fish and Game

Rick Hopkins, Live Oak Associates

*The Management and Conservation of Mountain Lions:
Reconciling Science, Public Opinion and Politics*
Christopher M. Papouchis and Lynn Michelle Cullens, Mountain Lion Foundation

*Cougar-Induced Indirect Effects: Does the Risk of
Predation Influence Ungulate Foraging Behavior on
the National Bison Range?*

David M. Choate and Gary E. Belovsky, University of Notre Dame
Michael L. Wolfe, Utah State University

1:30 p.m. - 3 p.m., Concurrent Session B, DeAnza Ballroom I

WOLF RECOVERY IN CALIFORNIA AND OREGON
Moderator: Nancy Weiss, Defenders of Wildlife

*Biodiversity of the Klamath-Siskiyou Ecoregion—An
Ecoregion in Search of Top Carnivores*
Brian Barr, World Wildlife Fund
Joseph Vaile, Klamath-Siskiyou Wildlands Center

California Indians and Wolves—An Interrupted Intimacy
Malcolm Margolin, Heyday Books

Wolves and Trophic Cascades in Yellowstone National Park
William J. Ripple, Oregon State University
Eric J. Larsen, University of Wisconsin-Stevens Point
Roy A. Renkin and Douglas W. Smith, Yellowstone Center for Resources

A Wolf Conservation Center for Northern California Wolf Recovery
Patrick Valentino, California Wolf Center

**1:30 p.m. - 3:00 p.m., Concurrent Session C,
DeAnza Ballroom II**

WOLVERINES IN THE CONTIGUOUS UNITED STATES
Moderator: Jeff Copeland, Idaho Department of Fish and Game

Wolverine Conservation: An Integrated Approach
James J. Claar, Len Ruggiero and Kevin McKelvey,
U.S. Forest Service, Rocky Mountain Research Station

AGENDA

Jeffrey Copeland, Idaho Department of Fish and Game
Marc Bosch, U.S. Forest Service

Historical Biogeography of the Wolverine in the United States

Kevin S. McKelvey and Pilar T. Rivera, U.S. Forest Service, Rocky Mountain Research Station
Keith B. Aubry, U.S. Forest Service, Pacific Northwest Research Station

Efficacy of Lures and Hair Snares To Detect Wolverine

Jeffrey P. Copeland, Idaho Department of Fish and Game/U.S. Forest Service, Rocky Mountain Research Station

Leonard F. Ruggiero and Kevin S. McKelvey, U.S. Forest Service, Rocky Mountain Research Station

Wolverine Distribution and Movements Relative to Landscape Features in the Pioneer, Flint and Anaconda/Pintler Mountains of Southwestern Montana

John Squires, Todd Ulizio and Leonard Ruggiero, U.S. Forest Service, Rocky Mountain Research Station

Wolverine Ecology and Management in the Greater Yellowstone Ecosystem—A Program Overview and Update

R. M. Inman, K. H. Inman, R. R. Wigglesworth and J. J. Beecham, Hornocker Wildlife Institute

3 p.m. - 3:30 p.m.

Coffee Break/Poster Session Open (DeAnza Foyer)

3:30 p.m. - 4:30 p.m.

Ambassador Wolf Session III – by reservation only (Redwood II)

3:30 p.m. - 5:30 p.m., Concurrent Session A, Monterey Conference Center, Steinbeck Forum COUGARS, CORES AND CORRIDORS

Moderator: Christopher Papouchis, Mountain Lion Foundation

Genetic Structure of Mountain Lion Populations in California and Nevada

Holly Ernest, University of California-Davis

Mountain Lions, Habitat Fragmentation and Wildlife Movement Corridors in Urbanizing Landscapes of Southern California

Raymond Sauvajot and Seth Riley, National Park Service

Influence of Vegetation, Roads and Urbanization on Cougar Habitat Use and Movement

*Brett Dickson, Colorado State University
Paul Beier, Northern Arizona University

Cougar Exploitation Levels in Utah: Implications for Demographic Structure, Metapopulation Dynamics and Population Recovery

*David Stoner, Michael Wolfe and Lisa Langs, Utah State University

Using Analysis and Modeling of Individual-Based Mountain Lion and Bobcat Movement To Access Landscape Connectivity in the Southern California Ecoregion

Jeff Tracey and Kevin Crooks, University of Wisconsin

Using Cougars To Design a Wilderness Network in California's South Coast Ecoregion

Paul Beier, Northern Arizona University
Kristeen Penrod, South Coast Wildlands Project

3:30 p.m. - 5:30 p.m., Concurrent Session B, DeAnza Ballroom I

CONFLICTS WITH AGRICULTURE AND OTHER WILDLIFE

Moderator: Suzanne Laverty, Defenders of Wildlife

Predicting Human-Carnivore Conflict: A Spatial Model Based on 25 Years of Wolf Predation on Livestock

Adrian Treves, Conservation International

Lisa Naughton, University of Wisconsin

Adrian Wydeven, Wisconsin Department of Natural Resources

Coexisting with Carnivores: Community-Based Approaches to Agricultural Conflicts

Camilla Fox, Animal Protection Institute

Cougars and Desert Bighorn Sheep in the Fra Cristobal Range: Adaptive Management of Predation

Kyran Kunkel and Zack Parsons, Turner Endangered Species Fund

AGENDA

Anthony Wright and Howard Quigley, Hornocker Wildlife Institute
Thomas Waddell, New Mexico Ranch Properties Inc.

*The Southern Alberta Conservation Cooperative:
Working with Ranchers To Reduce Conflicts with
Wolves*

Marco Musiani, University of Calgary
Charles Mamo, Carolyn Callaghan and Mike Going,
Central Rockies Wolf Project

*An Adaptive Strategy for Nonlethal Management of
Wolves in Idaho*

Stewart W. Breck and John A. Shivik, National
Wildlife Research Center
Rick Williamson, USDA Wildlife Services
Carter Niemeyer, U.S. Fish and Wildlife Service

*“Cultural Carrying Capacity” vs. Coexistence with
Carnivores*

Karlyn Atkinson Berg, Humane Society of the United
States

**3:30 p.m. - 5:30 p.m., Concurrent Session C,
DeAnza Ballroom II**

FOXES

Moderator: Gary Roemer, New Mexico State University

*The Foraging Behavior and Conservation of the Critically
Endangered Island Fox*

Gary Roemer and Andrea Ernst, New Mexico State
University
Catherine A. Schwemm, National Park Service

*Island Fox Recovery Program on the Northern Channel
Islands, California*

Timothy Coonan, Keith Rutz and Catherine A.
Schwemm, National Park Service
David K. Garcelon, Institute for Wildlife Studies
Gary W. Roemer, New Mexico State University
Linda Munson, University of California-Davis
Cheryl S. Asa, St. Louis Zoological Park

*Endangered San Joaquin Kit Fox and Non-Native Red
Fox: Interspecific Competitive Interactions*

Howard Clark Jr., Daniel F. Williams, Patrick A. Kelly
and Brian L. Cypher, California State University-

Stanislaus
Gregory D. Warrick, Center for Natural Lands
Management
David Grubbs, California State University-Fresno

*Resource Partitioning and Interspecific Competition
Between Coyotes and Red Foxes on an Island During
Recent Colonization by Coyotes*

*Angela Fuller and Daniel Harrison, University of
Maine

*A Case Study in Evaluation of Carnivore Conservation
Efforts: The Blackfeet Swift Fox Reintroduction
Program*

Devra G. Kleiman and Katherine Ralls, Smithsonian
National Zoological Park

*Measuring the Abundance of an Elusive Carnivore: The
Red Fox in Northeast Ireland*

*Declan O’Mahony and W.I. Montgomery, Queens
University

Murray Grant, Royal Society for the Protection of
Birds

Jonathan Reynolds, Game Conservancy Trust

5 p.m. - 7 p.m.

Silent Auction and Book Signing (DeAnza Foyer)
(see “Conference Events” for details)

7 p.m. - 10 p.m.

Banquet (DeAnza Ballroom I and II)
Sustainable Seas: The Vision, The Reality
Sylvia Earle, Deep Ocean Exploration and Research

Tuesday, November 19, 2002

7:30 a.m. - 3 p.m.

Registration (DeAnza Foyer)

7:30 a.m. - 6 p.m.

Speaker Prep Room Available (Redwood I)

**8 a.m. - 10 a.m., Concurrent Session A,
Monterey Conference Center, Steinbeck Forum**

WOLF RECOVERY AND BIOLOGY (I)

Moderator: Edward Bangs, U.S. Fish and Wildlife Service

Changes to the Status of the Gray Wolf Under the Endangered Species Act

Ronald Refsnider, U.S. Fish and Wildlife Service

Gray Wolf Restoration in the Northwestern United States

Edward Bangs, Joe Fontaine, Mike Jimenez, Tom Meier and Carter Niemeyer, U.S. Fish and Wildlife Service

Doug Smith and Deb Guernsey, National Park Service

Curt Mack, Nez Perce Tribe

Val Asher, Turner Endangered Species Fund

Mexican Wolf Recovery: Status, Three-Year Review and Current Challenges

Brian T. Kelly, U.S. Fish and Wildlife Service

Adaptive Management of Red Wolves in Northeast North Carolina

Bud Fazio, U.S. Fish and Wildlife Service

Growing Pains: Learning to Live with a Growing Wolf Population

Holly Jaycox, Wolf Park

Landscape-Level and Within-Territory Habitat Selection of Recolonizing Gray Wolves in Northwest Wisconsin

*Paul Keenlance and Kelly F. Millenbah, Michigan State University

Bruce E. Kohn, Wisconsin Department of Natural Resources

8 a.m. - 10 a.m., Concurrent Session B, DeAnza Ballroom I

MESOCARNIVORES

Moderator: Caroline Kennedy, Defenders of Wildlife

Multi-Scale Habitat Selection by American Martens in the Coastal Forests of Northwestern California

Keith M. Slauson, William J. Zielinski and John P. Hayes, Oregon State University

Predicting Habitat Supply for American Marten Using Measures of Landscape Composition and

Configuration

Jeffrey Hepinstall, University of Washington
Daniel Harrison and Angela K. Fuller, University of Maine

David C. Payer, Arctic National Wildlife Refuge

Distribution and Co-Occurrence of Mesocarnivores in the Central and Southern Sierra Nevada

Lori Campbell, U.S. Forest Service

Integrating Rare Carnivores into Large-Scale Land Management Planning in the Sierra Nevada Mountains of California

Diane Macfarlane, U.S. Forest Service

Multi-Carnivore Conservation Strategy For the American West

David Gaillard, Predator Conservation Alliance

Conservation Implications of a New Phylogenetic Hypothesis for the Mustelidae Based on Nuclear and Mitochondrial DNA Sequences

*Klaus-Peter Koepfli and Robert K. Wayne, University of California-Los Angeles

8 a.m. - 10 a.m., Concurrent Session C, DeAnza Ballroom II

SWIFT FOXES

Moderator: Axel Moehrenschlager, Calgary Zoo

Dispersal and Survival Parameters of Translocated and Resident Swift Foxes in Canada

Axel Moehrenschlager, Calgary Zoo

David W. Macdonald, Oxford University

Effect of Coyote Removal on Swift Fox Population Ecology

*Seija M. Karki, Utah State University
Eric M. Gese, USDA National Wildlife Research Center

Genetic Relatedness and Spatial Ecology of the Swift Fox

*Ann M. Kitchen, Seija M. Karki and Edward R. Schauster, Utah State University

Eric M. Gese, USDA National Wildlife Research Center

Behavioral Trait Assessment and Noninvasive Monitoring-Methods of Improving Reintroduction of Captive-Bred Swift Fox

*Samantha Bremner-Harrison, R. W. Elwood and P.

AGENDA

Prodohl, Queen's University Belfast

Population Survey Methods for Swift Fox in New Mexico
Robert Harrison, Daniel Barr and Jerry Dragoo,
University of New Mexico

Introduction to Native American Tribal Fish and Wildlife Operations
Ira Newbreast, Native American Fish and Wildlife Society

8:30 a.m. - 5 p.m.
Exhibit Hall Open (DeAnza Ballroom III)

10 a.m. - 10:30 a.m.
Coffee Break/Poster Session Open (DeAnza Foyer)

10:30 a.m. - 11:30 a.m.
Ambassador Wolf Session IV - by reservation only (Redwood II)

10:30 a.m. - Noon, Concurrent Session A, Monterey Conference Center, Steinbeck Forum
WOLF RECOVERY IN THE SOUTHERN ROCKIES
Moderator: Craig Miller, Defenders of Wildlife

Wolf Recovery in the Southern Rockies
Michael K. Phillips, Turner Endangered Species Fund

Wolf Recovery in the Southern Rocky Mountains: Evaluating Biological Feasibility
Carlos Carroll, Klamath Center for Conservation Research
Michael K. Phillips, Turner Endangered Species Fund

Restoring Wolves to the Southern Rockies: The Nexus of Science and Advocacy
Rob Edward, SINAPU

Wolves in Utah: An Analysis of Potential Impacts and Recommendations for Management
Trey Simmons and Robert H. Schmidt, Utah State University
T. Adam Switalski, Wildlands Center for Preventing Roads

10:30 a.m. - Noon, Concurrent Session A, DeAnza Ballroom I

URBAN CARNIVORES (I)
Moderator: Seth Riley, National Park Service

A Comparative Study of the Urban Ecology of Striped Skunks and Raccoons in a Major Metropolitan Area
Stanley Gehrt, Max McGraw Wildlife Foundation

Coyote Movements, Spatial Organization and Landscape Use in the Chicago Region
Stanley Gehrt, Max McGraw Wildlife Foundation
Paul Morey and Eric M. Gese, USDA National Wildlife Research Center
Chris Anchor, Forest Preserve District of Cook County

Raccoon Home Range and Habitat Use Patterns in an Urban National Park
John Hadidian, The Humane Society
Seth Riley, D. M. Manski and T. Stidham, National Park Service

Life History Comparisons of Sympatric Urban and Rural Foxes in Central Illinois
Todd E. Gosselink, Iowa Department of Natural Resources
Timothy R. Van Deelen, Wisconsin Department of Natural Resources
Richard E. Warner, University of Illinois

Changing Dynamics of a Black Bear Population: Causes and Consequences
Jon P. Beckmann, University of Nevada

10:30 a.m. - Noon, Concurrent Session C, DeAnza Ballroom II
BLACK-FOOTED FERRETS
Moderator: Minette Johnson, Defenders of Wildlife

Black-Footed Ferret Recovery Potential Across the Great Plains
Jonathan Proctor, Predator Conservation Alliance

The Decline and Recovery of Black-Footed Ferrets: Recovery Program Successes and Continuing Challenges
Mike Lockhart and Paul Marinari, U.S. Fish and Wildlife Service

AGENDA

*Black-Footed Ferret Reintroduction in South Dakota:
Challenges and Successes*

Travis M. Livieri, Prairie Wildlife Research

The Impact of Sylvatic Plague on Recovery of Black-Footed Ferrets

Tonie Rocke and Jordan Mencher, USGS

Noon - 1:30 p.m.

Lunch Break

12:15 p.m. - 1:15 p.m., State Wildlife Manager Session, Ironwood Room

How To IMPLEMENT A LIVING WITH CARNIVORES PROGRAM

(see "Conference Events" for details)

Moderator: Nancy Weiss, Defenders of Wildlife

Doug Zimmer, U.S. Fish and Wildlife Service

Julie Palmquist, Wolf Haven

12:30 p.m. - 1:15 p.m., Lunchtime Speaker, Monterey Conference Center, Steinbeck Forum

Rewilding North America: The Wildlands Project's Megalinkage Approach

Dave Foreman, The Wildlands Project

1:30 p.m. - 2:30 p.m.

Ambassador Wolf Session V – by reservation only (Redwood II)

1:30 p.m. - 3 p.m., Concurrent Session A, Monterey Conference Center, Steinbeck Forum

LEAD TOXICITY IN WILDLIFE

Moderator: Kelly Sorenson, Ventana Wilderness Society

Lead Poisoning of North American Wildlife from Ammunition and Fishing Tackle

Wendy Sanborn, HawkWatch International

Lead Poisoning in Bald Eagles in the Upper Midwest

Patrick Redig, University of Minnesota

Vulnerability of Condors to Lead Exposure and Intoxication

Michael Fry and Jeffery R. Maurer, University of California-Davis

Oliver H. Patee, James W. Carpenter and Steven H. Fritts, USGS Patuxent Wildlife Research Center

Lead Replacement Technology

Vic Oltrogge, Silver Cartridge Company

1:30 p.m. - 3 p.m., Concurrent Session B, DeAnza Ballroom I

URBAN CARNIVORES (II)

Moderator: John Hadidian, The Humane Society

Bobcat Reproduction Relative to Urbanization and Fragmentation in Southern California

Cassity Bromley, Seth P. D. Riley, Piper Roby, Kimberly Asmus and Raymond M. Sauvajot, National Park Service

Birds of Prey in Urban Landscapes

Clint W. Boal, USGS Texas Cooperative Research Unit R. William Mannan, University of Arizona

Conservation of Endangered San Joaquin Kit Foxes in Urban Environments

Brian Cypher and Christine L. Van Horn Job, California State University-Stanislaus

Coyotes, Fishers and Housecats in a Northeast Suburban Forest Preserve

Roland Kays and Daniel Bogan, New York State Museum

1:30 p.m. - 3 p.m., Concurrent Session C, DeAnza Ballroom II

LYNX BIOLOGY AND CONSERVATION

Moderator: John Squires, U.S. Forest Service, Rocky Mountain Research Station

Canada Lynx Habitat, Forest Harvest Strategies and Regeneration in Northern Maine

Christopher Hoving, Daniel J. Harrison and William B. Krohn, University of Maine
Walter J. Jakubas, Maine Department of Inland Fisheries and Wildlife

AGENDA

Effects of Precommercial Thinning on Snowshoe Hare in Maine: Implications for Canada Lynx

*Jessica Homyack, Daniel J. Harrison and William B. Krohn, University of Maine

Lynx Ecology in Northwestern Montana: An Ongoing Field Study at Seeley Lake

John R. Squires and Leonard F. Ruggiero, U.S. Forest Service, Rocky Mountain Research Station

Diet and Predatory Behavior of Lynx in Sweden

*Charlotte Moshøj, University of Copenhagen

3 p.m. - 3:30 p.m.

Coffee Break/Poster Session Open (DeAnza Foyer)

3:30 p.m. - 4:30 p.m.

Ambassador Wolf Session VI – by reservation only (Redwood II)

3:30 p.m. - 5:30 p.m., Concurrent Session A, Monterey Conference Center, Steinbeck Forum

WOLF RECOVERY AND BIOLOGY (II)

Moderator: Mike Phillips, Turner Endangered Species Fund

A GIS Analysis and Model of Suitable Habitat for the Red Wolf in North Carolina

*Brian Eckert, Pennsylvania State University

Effects of Habitat Preferences and Competition with Coyotes on Introgression and Extinction in Red Wolves

*Richard Fredrickson, Arizona State University

Winter Wolf Predation in an Elk-Bison System in Yellowstone National Park, Wyoming

Rosemary Jaffe, Robert A. Garrott and John J. Borkowski, Montana State University

Wolf-Mediated Scavenger Food Webs in Yellowstone National Park

*Christopher Wilmers and Wayne M. Getz, University of California-Berkeley

Robert L. Crabtree, Yellowstone Ecological Research Center

Douglas W. Smith, Yellowstone Center for Resources

Issues Facing Educators in Light of Federal and State Reclassification of Wolves in Michigan and Wisconsin

Pam Troxell, Timber Wolf Alliance

Teaching About Wolves to Urban and Rural Students

Steve Wadlow, The Central Rockies Wolf Project

3:30 p.m. - 5:30 p.m., Concurrent Session B,

DeAnza Ballroom I

SEALS AND SEA LIONS

Moderator: Jim Harvey, Moss Landing Marine Laboratories

Aerial Vocal Development in Captive Harbor Seal Pups, Phoca vitulina richardsi and Phoca vitulina concolor

*Christin B. Khan and Hal Markowitz, San Francisco State University

Brenda McCowan, University of California-Davis

Contaminant-Induced Immune Alterations in the Harbor Seal

*Jennifer C. C. Neale, Thomas P. Kenny, Kara R. Schmelzer, Elizabeth A. Berg, Judith A. Van de Water, Eric M. Gershwin and Ronald L. Tjeerdema, University of California-Davis

James T. Harvey, California State University

Pacific Harbor Seal Foraging on Listed Winter-Run Steelhead in the San Lorenzo River, California

*Michael Weise and James T. Harvey, Moss Landing Marine Laboratories

Quality vs. Quantity of Prey: Nutritional Stress and the Decline of Steller Sea Lions in Alaska

Andrew Trites, David A. S. Rosen and Arliss J. Winship, University of British Columbia

Steller Sea Lions and High-Quality Ephemeral Prey Species in Southeastern Alaska

Jamie N. Womble, Mary F. Willson and Brendan P. Kelly, University of Alaska-Fairbanks

Michael F. Sigler, National Marine Fisheries Service

Benthic vs. Epipelagic Foraging in Diving Mammals: Ecological and Physiological Implications

Daniel Costa, University of California-Santa Cruz

Nicholas J. Gales, Australian Antarctic Division

AGENDA

**3:30 p.m. - 5:30 p.m., Concurrent Session B,
DeAnza Ballroom II**

KIT FOXES

Moderator: Brian L. Cypher, University of California-Stanislaus

Life and Death in the Cotton Fields: Conservation and Recovery of the Endangered San Joaquin Kit Fox
Patrick Kelly, Howard Clark and Daniel Williams, California State University
Gregory Warrick, Center of Natural Lands Management

Feeding Habits and Home Range Size of the Kit Fox in the Chihuahuan Desert, Mexico

Jorge Servín, Universidad Juárez del Estado de Durango
Elias Chacón, Delegación Federal SEMARNAT en Durango

The Challenges of Determining Habitat Preference for a Declining Kit Fox Population on Dugway Proving Ground, Utah

*Adam Kozlowski, Utah State University
Eric M. Gese, USDA National Wildlife Research Center

Characteristics of Refugia Used by Urban San Joaquin Kit Foxes

Christine Van Horn Job and Brian L. Cypher, California State University-Stanislaus

Scat-Sniffing Dogs and Fecal DNA Analyses: Comparing Noninvasive Techniques with Radio Telemetry Monitoring

*Deborah Smith, University of Washington
Katherine Ralls, Smithsonian National Zoological Park
Brice Adams and Jesús E. Maldonado, National Museum of Natural History
Brian L. Cypher, California State University-Stanislaus

Kinship and Parentage in Urban San Joaquin Kit Foxes
Katherine Ralls, Smithsonian National Zoological Park
Brian L. Cypher and Christine Van Horn Job, California State University-Stanislaus
Maria del Rosario Franco and Jesús E. Maldonado, National Museum of Natural History

6 p.m. - 8 p.m., Ironwood Room

IUCN Canid Specialist Group
(see "Conference Events" for details)

6 p.m. - 8 p.m., Bonzai Ballroom

All Things Mountain Lion
(see "Conference Events" for details)

6 p.m. - 9 p.m., Cottonwood Room

Wolverine Conservation Meeting
(see "Conference Events" for details)

Wednesday, November 20, 2002

7:30 a.m. - 10 a.m.

Registration (DeAnza Foyer)

8 a.m. - 10 a.m., Concurrent Session A, DeAnza Ballroom I

SEA OTTER POPULATION STUDIES

Moderator: James Estes, USGS Santa Cruz Field Station

Southern Sea Otter Demography and Population Analyses

M. Tim Tinker and Daniel F. Doak, University of California-Santa Cruz

Assessing Population Status Using Activity Budgets: Inter- and Intra-Population Differences in Foraging Effort

James Bodkin, USGS Alaska Science Center
Michelle L. Staedler, Monterey Bay Aquarium
M. Tim Tinker and James A. Estes, University of California-Santa Cruz

Southern Sea Otter Survival: Risks, Rehabilitation and Responsibilities

Krista Hanni and Jonna A. K. Mazet, Wildlife Health Center

Frances M.D. Gulland, The Marine Mammal Center
James A. Estes, University of California-Santa Cruz
Michelle Staedler, Monterey Bay Aquarium
David A. Jessup, Marine Wildlife Veterinary Care and Research Center

Analysis of Rehabilitation Data from the Sea Otter Research and Conservation Program at the Monterey Bay Aquarium

Andrew Johnson, Karl Mayer, Teri Nicholson, Michelle Staedler and Julie Hymer, Monterey Bay

AGENDA

Aquarium

Causes of Mortality in California Sea Otters Based on Death Assemblage Analysis

James Estes and B. B. Hatfield, USGS Santa Cruz Field Station

Katherine Ralls, Smithsonian National Zoological Park
J. A. Ames, California Department of Fish and Game

Are Sea Otters Suffering from Inbreeding Depression?

Shawn Larson, Seattle Aquarium
Ron Jameson, Brenda Ballachey and Dan Monson,
USGS
Sam Wasser, Center for Conservation Biology

8 a.m. - 10 a.m., Concurrent Session B, DeAnza

Ballroom II

COYOTES

Moderator: Thomas DeLiberto, USDA Wildlife Services

Coyotes, Sheep and Wild Prey: A Model System for Predator-Prey Relationships in Mediterranean Climates

*Benjamin Sacks, University of California-Davis

Home Range and Habitat Use of Coyotes in Michigan
Justin S. Stevenson, Holly J. Smith and Thomas DeLiberto, USDA Wildlife Services

Comparison of Reproductive Hormone Patterns in Pregnant and Pseudo-Pregnant Coyotes

*Debra Carlson, Utah State University
Thomas DeLiberto, USDA Wildlife Services

Can Diversion Feeding Be Successful in Reducing Coyote Predation of Western Snowy Plover Nests?

M. Paloma Nieto, SRS Technologies

Temporal Genetic Variation in a High Turnover Coyote Population

Christen L. Williams, John J. Johnston and Mike M. Jaeger, USDA Wildlife Services
Karen Blejwas, University of California-Berkeley

Influence of Extender, Freezing Rate and Thawing Rate on Post-Thaw Motility and Morphology of Coyote Spermatozoa

*Larry Minter, Utah State University
Thomas DeLiberto, USDA Wildlife Services

8 a.m. - 10 a.m., Concurrent Session C, Ironwood Room

METHODOLOGIES FOR CARNIVORE RESEARCH
Moderator: Robert Long, University of Vermont

Counting Tigers With Confidence

*Sandeep Sharma, Wildlife Institute of India

Individual Variation in Gray Wolf Squeak Vocalizations
Fred Harrington, Mount Saint Vincent University

Long-Range Migration of the Salmon Shark and the White Shark

*Kevin Weng, Hopkins Marine Station

Density of Old-Growth Trees in the Central Sierra Nevada: Do Spotted Owl Nesting Areas Reflect Densities Found in Old-Forest Areas?

Monica Bond, Mark E. Seamans and R. J. Gutiérrez, University of Minnesota

Scat-Sniffing Dogs as a Tool For Studying Forest Carnivores in Vermont

*Robert Long, Therese M. Donovan, Paula MacKay and Jeffrey S. Buzas, University of Vermont
William J. Zielinski, U.S. Forest Service

Effectiveness of Playback Surveys as a Sole Method To Locate Active Goshawk Nests

*Keenan Doolittle, Drummond High School
Tom Doolittle, Bad River Indian Reservation

8:30 a.m. - 3:30 p.m.

Exhibit Hall Open (DeAnza III Ballroom)

10 a.m. - 10:30 a.m.

Coffee Break/Poster Session Open (DeAnza Foyer)

10:30 a.m. - Noon, Concurrent Session A,

DeAnza Ballroom I

SEA OTTER THREATS

Moderator: David Jessup, Marine Wildlife Veterinary

AGENDA

- Care and Research Center
- A Marine Carnivore, the Southern Sea Otter, as a Sentinel of Pathogen and Chemical Pollution*
David Jessup and Melissa Miller, Marine Wildlife Veterinary Care and Research Center
Christine Kreuder, Patricia Conrad and Jonna A. K. Mazet, University of California-Davis
- Recent Causes of Mortality in Southern Sea Otters*
Christine Kreuder, Linda J. Lowenstine, Tim E. Carpenter, Patricia A. Conrad and Jonna A. K. Mazet, University of California-Davis
Melissa A. Miller, David Jessup, Michael D. Harris and Jack A. Ames, Marine Wildlife Veterinary Care and Research Center
- Sea Otters in Prince William Sound, Alaska: Status of Recovery 12 Years After the Exxon Valdez Oil Spill*
Brenda Ballachey, James L. Bodkin and Daniel H. Monson, USGS Alaska Science Center
Paul W. Snyder, Purdue University
- Chemical Contaminants and Disease in Sea Otters: A Collaborative Approach to Funding and Research*
Steve Shimek, The Otter Project
-
- 10:30 a.m. - Noon, Concurrent Session B, DeAnza Ballroom II**
- EFFECTS OF HABITAT FRAGMENTATION ON CARNIVORE POPULATIONS**
Moderator: Trisha White, Defenders of Wildlife
- Responses of Carnivore Communities to Landscape Change in the Adirondacks, New York*
Justina Ray, Wildlife Conservation Society
Roland Kays, New York State Museum
Matthew E. Gompper, University of Missouri-Columbia
- Ecology of a Large Predator in a Small Park: The Wolf in La Mauricie National Park*
*Mario Villemure, University of Sherbrooke
- Landscape-Level Correlates of Fragmentation on Home-Range Overlap in Eastern Coyotes*
*Todd Atwood, Utah State University
Harmon P. Weeks, Purdue University
-
- The Influence of Linear Features on Wolf Movements in the Central Rocky Mountains, Canada*
Carolyn Callaghan, University of Guelph
Paul Paquet, University of Calgary
-
- 10:30 a.m. - Noon, Concurrent Session C, Ironwood Room**
- SOUTH AMERICAN CARNIVORES**
Moderator: Gerald Zuercher, Kansas Cooperative Fish and Wildlife Unit
- Comparative Analysis and Ecological Implications of the Biomass Eaten by Four Species of Small Neotropical Cats in the Wild and in Captivity*
Tadeu G. de Oliveira, Maranhão State University
*Rogério Cunha de Paula, Associação Pró-Carnívoros
- Effects of Human Activities on Carnivores of the Cerrado Ecosystem of Brazil*
*Rogério Cunha de Paula, Associação Pró-Carnívoros
- Local Perceptions of Jaguars and Pumas in the Iguaçu National Park Area, South Brazil*
*Valeria Amorim Conforti, University of Idaho
Fernando Cesar Caselli de Azevedo, Associação Pró-Carnívoros
- Jaguar Predation on Livestock: A Reported Case of a "Problem Animal"*
*Fernando Cesar Caselli de Azvedo, Associação Pró-Carnívoros
Valeria Amorim Conforti, University of Idaho
- Dietary Separation and Overlap Between Mammalian Carnivores in Eastern Paraguay: Evidence from the Dry Season*
Gerald Zuercher and Philip Gipson, Kansas Cooperative Fish and Wildlife Research Unit
-
- Noon - 1:30 p.m.**
- Lunch Break
- 12:15 p.m. - 1:15 p.m. (DeAnza Ballroom I)**
- Presentation and Discussion of *On Nature's Terms*, hosted by Sharon Negri, WildFutures (see "Conference Events" for details)

AGENDA

12:15 p.m. - 1:15 p.m., DeAnza Ballroom II

RECOVERY OF RARE CARNIVORES

Moderator: Nina Fascione, Defenders of Wildlife

Jaguar Ecology in Sonora, Mexico: Tools for its Recovery and Protection in Arizona

Carlos A. Lopez Gonzalez, Universidad Autonoma de Queretano

Samia E. Carrillo Percastegui, Proyecto Distribucion

Building Tolerance for Bear and Wolf Recovery

Minette Johnson, Defenders of Wildlife

Mexican Wolves: Status Report and Challenges Facing the Captive-Breeding Program

Daniel Moriarty, University of San Diego

Patrick Valentino, California Wolf Center

12:15 p.m. - 1:15 p.m., Redwood Room

Badger Conservation Meeting

(see "Conference Events" for details)

1:30 p.m. - 3 p.m. Concurrent Session A, DeAnza Ballroom I

SEA OTTER BEHAVIOR AND PHYSIOLOGY

Moderator: Andy Johnson, Monterey Bay Aquarium

Foraging Ecology: Sources of Variation in Dive Behavior, Diet and Foraging Success

M. Tim Tinker and James A. Estes, University of California-Santa Cruz

Michelle Staedler, Monterey Bay Aquarium

James L. Bodkin, USGS Alaska Science Center

Application of Individual-Based Movement Models to Movement Patterns of California Sea Otters

Alisha H. Kage, M. Tim Tinker and Daniel F. Doak, University of California-Santa Cruz

James A. Estes, USGS Santa Cruz Field Station

Nocturnal Foraging Ecology of the Sea Otter in Elkhorn Slough, California

Sarah Wilkin, Moss Landing Marine Laboratories

Thermoregulation and Diving Energetics of the California Sea Otter: Are They Pushing Their Physiological Limits?

Laura Yeates, Terrie M. Williams and M. Tim Tinker,
University of California-Santa Cruz

1:30 p.m. - 3 p.m. Concurrent Session B, DeAnza Ballroom II

LANDSCAPE LINKAGES

Moderator: Bill Ruediger, U.S. Forest Service

Wildlife Linkage Areas: An Integrated Approach for Canada Lynx

James Claar, Timothy Bertram, Robert Naney and Nancy Warren, U.S. Forest Service

Ecosystem Scale Linkage Identification and Implementation for Grizzly Bears and Other Rocky Mountain Carnivores

Christopher Servheen, John Waller and Wayne Kasworm, U.S. Fish and Wildlife Service

A Regional Assessment of Landscape Permeability for Large Carnivores in the Pacific Northwest

Peter Singleton, U.S. Forest Service

High, Wide and Handsome: Designing More Effective Carnivore Crossings for Roads and Highways

Bill Ruediger, U.S. Forest Service

1:30 p.m. - 3 p.m. Concurrent Session C, Ironwood Room

CARNIVORE DISEASES

Moderator: Krista Hanni, Wildlife Health Center

Disease Ecology of Wild and Domestic Carnivores in the Bolivian Chaco

*Christine Fiorello, Columbia University

Sharon L. Deem, Wildlife Conservation Society

Andrew J. Noss, Proyecto Kaa-Iya

The Role of Infectious Disease in the Decline of Island Fox Populations in the Channel Islands, California

Deana Fritch, Jonna A. K. Mazet, Rosie Woodroffe and Linda Munson, University of California-Davis Steven F. Timm and David K. Garcelon, Institute for Wildlife Studies

Tim Coonan, National Park Service

Emerging Diseases in Marine Ecosystems: Protozoal

AGENDA

- Encephalitis in Sea Otters*
Melissa Miller, D. A. Jessup, E. Dodd, M. D. Harris
and J. Ames, Marine Wildlife Veterinary Care and
Research Center
- I. A. Gardner, C. Krueger, K. D. Hanni, J. K. Mazet, L.
J. Lowenstine, A. Packham and P. A. Conrad,
University of California-Davis
- D. M. Paradies, Bay Foundation of Morro Bay
- K. R. Worcester, Central Coast Regional Water Quality
Control Board
- P. R. Crosbie, California State University-Fresno
- F. M. Gulland, The Marine Mammal Center
- J. Estes, USGS Santa Cruz Field Station
- R. Jameson, Western Ecological Health Center
- Avian Vacuolar Myelinopathy in Southeastern United
States—an Emerging Neurologic Disease of Bald
Eagles*
Tonie Rocke, Nancy Thomas and Kimberli Miller,
National Wildlife Health Center
- John Fischer, University of Georgia
- Tom Augspurger, U.S. Fish and Wildlife Service
- 3 p.m. - 3:30 p.m.**
Coffee Break/Poster Session Open (DeAnza Foyer)
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- 3:30 p.m. - 5:30 p.m. Concurrent Session A,
DeAnza Ballroom I**
WHALES AND DOLPHINS
Moderator: Bernd Würsig, Texas A & M University
- Going With the Floe: Killer Whale Specialization and
Speciation in Antarctica*
Richard LeDuc and Robert L. Pitman, Southwest
Fisheries Science Center
- Organochlorine Contaminant Levels in Eastern North
Pacific Killer Whales*
Gina Ylitalo, M.M. Krahn, D. Boyd and G. K.
Yanagida, National Marine Fisheries Service
- M. E. Dahlheim, National Marine Mammal Laboratory
- R. A. Hoezel, University of Durham
- N. Black, Monterey Bay Cetacean Project
- Predation Rate and Prey Preferences of Southeast
Alaskan Transient Killer Whales*
Marilyn Dahlheim, National Marine Mammal
- Laboratory*
Paula A. White, Museum of Vertebrate Zoology
- Interactions Between Dusky Dolphins and Other Marine
Mammals in New Zealand*
*Tim Markowitz, Bernd Würsig and April D. Harlin,
Texas A & M University
- Behavioral Ecology of Insular Spinner Dolphin
Populations: Implications for Conservation and
Management of the Northwest Hawaiian Region*
Leszek Karczmarski and Bernd Würsig, Texas A & M
University
- Kimberly Andrews, University of Hawaii
- Harbor Porpoise Interactions with Selective Salmon
Fisheries in Southern British Columbia*
*Anna Hall and Andrew W. Trites, University of
British Columbia
- Graeme Ellis, Fisheries and Oceans Canada
-
- 3:30 p.m. - 5:30 p.m. Concurrent Session B,
DeAnza Ballroom II**
**CONSERVATION AND MANAGEMENT OF NORTH
AMERICAN BEARS**
Moderator: Martin Smith, Defenders of Wildlife
- Perspectives in Grizzly Bear Conservation: Repre-sen-tations from Newspaper and Magazine Articles*
David Mattson, USGS Forest and Rangeland
Ecosystem Science Center
- Seth Wilson, University of Montana
- Grizzly Bear Recovery Efforts in the Cabinet-Yaak and
Selkirk Mountains Recovery Zones*
Wayne Kasworm, U.S. Fish and Wildlife Service
- Wayne Wakkinen, Idaho Department of Fish and Game
- Recovery of Grizzlies in the North Cascades Ecosystem:
Obstacles and Opportunities*
Joe Scott, Northwest Ecosystem Alliance
- Effects of Human Activities on Brown Bears at Hallo Bay,
Katmai National Park and Preserve, Alaska*
Blair French and Erich H. Follmann, University of
Alaska-Fairbanks
- Tom S. Smith, USGS Biological Resources Division
- Kyran E. Kunkel, Turner Endangered Species Fund

AGENDA

The Florida Black Bear: Reducing Risks and Reaching for Recovery in a Rapidly Urbanizing State
Laurie Macdonald, Defenders of Wildlife

Reproduction in Female Black Bears: Monitoring Pre- and Post-Natal Development in Cubs
*Colleen Olfenbuttel, Nikki Parker and Michael Vaughan, Virginia Polytechnic Institute and State University

3:30 p.m. - 5:30 p.m., Concurrent Session C, Ironwood Room

CARNIVORES AROUND THE WORLD

Moderator: William Burns, American Society of International Law

Conservation and Ecology of the Liberian Mongoose in the Swamp Forests of the Ivory Coast
Amy E. Dunham, State University of New York at Stony Brook

Conservation of Grassland Carnivores in Chihuahua, Mexico
Rurik List, Jesús Pacheco, Gerardo Ceballos, Universidad Nacional Autónoma de México

Raptor Electrocutions in Power Lines in Mexico: A Diagnosis and Perspectives for Solution
Patricia Manzano-Fischer, Agrupación Dodo

Coexistence of African Wild Dogs with People in Northern Kenya
Rosie Woodroffe, University of California-Davis

Mountain-Dwelling Ethiopian Wolf Population Status and Conservation Challenges
Claudio Sillero-Zubiri, Jorgelina Marino, Oxford University
M. Karen Laurenson, University of Edinburgh
Stuart D. Williams, Ethiopian Wolf Conservation Program

Climate Change and Its Potential Impacts on Carnivores
William Burns, American Society of International Law

Poster Presentations

(On display in DeAnza Foyer throughout conference)

Dead Sea Otter Drift and Recovery in Central California
Jack Ames, California Department of Fish and Game
Michelle Staedler, Monterey Bay Aquarium

Extirpation and Reintroduction of Fishers in Oregon: Implications for their Recovery in the Pacific States
Keith Aubry, U.S. Forest Service

Preserving the Peaceable Kingdom: Investigating the Relationships Between Marine Recreation and Sea Otters in the Monterey Bay
Deborah M. Benham, Thea Sinclair and Sarah Collins, University of Nottingham
Ashley Dayer, U.S. Fish and Wildlife Service

Occurrence, Behavior and Photo-Identification of Killer Whales in Monterey Bay, California
Nancy Black, Richard Ternullo, Alisa Schulman-Janiger, Anne Marie Hammers and Peggy Step, Monterey Bay Cetacean Project

A Wildland Conservation Assessment for the Central Coast of California
Dick Cameron, GreenInfo Network
Jim Thorne, University of California-Davis
Verna Jigour, Coast Ranges Ecosystem Alliance

Suburban Residents' Knowledge of and Attitudes Toward Mountain Lions
Anne L. Casey, P. R. Krausman and W. W. Shaw, University of Arizona
H. G. Shaw, Hillsboro, New Mexico

Chemical Restraint of South American Coatis with a combination of Teletamine and Zolazepam (Zoletil®)
*Valeria Amorim Conforti and Fernando Cesar Cascelli de Azevedo, Associação Pró-Carnívoros

Interactions Between Bears and Humans Along the Chilkoot River In Haines, Alaska: Using the Present To Plan the Future
Anthony P. Crupi and Barrie K. Gilbert, Utah State University

Use of Artificial Dens To Conserve Endangered San Joaquin Kit Foxes
Brian Cypher, Alexander Brown, Patrick Kelly and Daniel Williams, University of California-Stanislaus

AGENDA

- Vocal Identity in the Swift Fox*
Safi K. Darden and Torben Dabelsteen, University of Copenhagen
- Prey and Fruit Selection in the Diet of the Maned Wolf in the Ecological Station of Itirapina, Southeastern Brazil*
*Adriana de Arruda Bueno and José C. Motta, Jr., Universidade de São Paulo
Vinicius Bonato, Universidade Estadual de Campinas
- Food Habits of the Syntropic Crab-Eating Fox and Maned Wolf in Southeastern Brazil*
*Adriana de Arruda Bueno, José C. Motta, Jr., Universidade de São Paulo
- The Bush Dog in Northern Brazil: Distribution, Habitat Use and Conservation*
Tadeu G. de Oliveira, Maranhão State University
- Little Spotted Cat Distribution and Habitat Association in the Americas*
Tadeu de Oliveira, Maranhão State University
- Preliminary Results of the Impacts of Excessive Human Contact on Behavior and Ecology of a Sub-Population of Maned Wolf at Serra de Canastra National Park, Brazil*
*Rogério Cunha de Paula, Associação Pró-Carnívoros
- Population Expansion as an Effect in the Decrease of Red Wolf Range from 1900-2000*
Brian T. Eckert, Pennsylvania State University
- Evaluation of Wolf Education Centers in the Continental United States*
*Brian T. Eckert, Pennsylvania State University
- Distribution and Abundance of Cougars in the Black Hills, South Dakota*
Dorothy M. Fecske, Jonathan A. Jenks, Vickie J. Smith, and Robert P. Dubreuil, South Dakota State University
- Christopher S. DePerno, Minnesota Department of Natural Resources
Fredrick G. Lindzey, USGS Biological Resources Division
- Assessing the Conservation Status of a Poorly-Known African Carnivore, the Johnston's Genet*
- Philippe Gaubert, Muséum National d'Histoire Naturelle
Amy E. Dunham, State University of New York at Stony Brook
- Color Patterns Among Wolves in Western North America*
Philip S. Gipson, Kansas Cooperative Fish and Wildlife Research Unit
Edward E. Bangs, Theodore N. Bailey, Diane K. Boyd and Michael D. Jimenez, U.S. Fish and Wildlife Service
H. Dean Cluff, Teller Wildlife Refuge
Douglas W. Smith, Yellowstone Center for Resources
- Jaguar Diets in Eastern Paraguay: Peccaries, Livestock and Other Carnivores*
Philip S. Gipson and Gerald L. Zuercher, Kansas Cooperative Fish and Wildlife Research Unit
- An Evaluation of the Potential Threats to Sea Otters Posed by Trap Fisheries*
Brian Hatfield and James Estes, USGS Santa Cruz Field Station
Andrew Johnson, Monterey Bay Aquarium
Jack Ames, California Department of Fish and Game
- Things Are Not Always as They Seem: Mortality and the Wildlife Pathologist*
Jack Hawkes, Debbie Brownstein, Melissa Miller and Dave Jessup, Marine Wildlife Veterinary Care and Research Center
Linda Lowenstine, University of California-Davis
- Evaluation of a High Density Polyethylene Collar for the Prevention of Coyote Predation on Sheep*
John Hill, InterTrade
Ned Simper, Utah State University
- Climate Change and Lynx: Spatial Occurrence Models in Eastern North America*
Christopher Hoving, Daniel J. Harrison and William B. Krohn, University of Maine
Ronald A. Joseph, U.S. Fish and Wildlife Service
Mike O'Brien, Nova Scotia Department of Natural Resources
- Distance Sampling Dilemmas*
Linda-Jane Irwin and Bernd Würsig, Texas A & M University

AGENDA

The SORAC Center: A Strategy for Sea Otter Research and Conservation

Andrew B. Johnson, Monterey Bay Aquarium

Using Frequencies of Social Interactions to Quantify the Hierarchical Structure within a Captive Gray Wolf Pack

*Pamela S. Johnson, Whitworth College

Fisher Population Monitoring in the Kings River Adaptive Management Area

Mark J. Jordan, Reginald H. Barrett and Per J. Palsbøll, University of California-Berkeley
Amie K. Mazzoni and Kathryn L. Purcell, U.S. Forest Service
Brian B. Boroski, H. T. Harvey and Associates

Mountain Lion Habitat Corridors and Bay Area Regional Planning

Michelle Korpos, Live Oak Associates, Inc.

Mediation of Foraging Behavior and Spatial Distribution of the Alaskan Sea Otter by Harmful Algal Blooms

Rikk Kvitek, Carrie Bretz and Kate Thomas, Seafloor Mapping Lab

DDT and PCB Levels in California Sea Lions

B. J. Le Bouef, J. P. Geisy, K. Kannan, N. Kajiwara, S. Tanabe and C. Debier, University of California-Santa Cruz

California Condors of the Colorado Plateau

Elaine Leslie, National Park Service

Assessment of the Conservation Status of Sierra Nevada Red Fox, Pacific Fisher and American Marten in the Sierra Nevada Mountains and Modoc Plateau of California

Diane C. Macfarlane, U.S. Forest Service

Density-Dependent Behavioral Traits Regulate the Recovery of an Ethiopian Wolf Population

Jorgelina Marino and Claudio Sillero-Zubiri, Oxford University

Bridging the Gap: African Wild Dog Ethology, Conservation and Management

E. Kim McCreery and Robert L. Robbins, African Wild Dog Conservancy

Feeding Ecology of the Barn Owl in the Ecological Station of Itirapina, Southeastern Brazil

José Carlos Motta, Jr. and Adriana de Arruda Bueno, Universidade de São Paulo

Trophic Ecology of the Maned Wolf in Southeastern and Central Brazil

José Carlos Motta, Jr., Adriana de Arruda Bueno, Sonia C. S. Belentani and Diego Queirolo, Universidade de São Paulo

Caribou and Wolf Migration and Wolf Populations in Tundra and Forest Ecosystems

Marco Musiani, Paul C. Paquet and C. Cormack Gates, University of Calgary
Carles Vilà, Uppsala University
H. Dean Cluff and Ann Gunn, Government of the Northwest Territories
Robert K. Wayne and Jennifer A. Leonard, University of California
Lyle R. Walton, Ontario Natural Resources

A Short-Term Diversion Feeding Trial To Reduce the Impact of Coyote Predation on a Federally Threatened Ground Nesting Bird Species

M. Paloma Nieto, SRS Technologies

Effectiveness of a Fladry Barrier in Captive Wolves

Shane Rilling, Laura Kelly, Heather Lindquist, Kevin Scully and Dan Moriarty, University of San Diego and the California Wolf Center

Hunting Behavior Strategy of Mexican Wolves

Jorge Servín, Universidad Juárez del Estado de Durango

Wolves in Maine: A Computer Model

Peggy Struhsacker, National Wildlife Federation

A Review of Short- and Long-Term Effects of Whale Watching on Killer Whales

Andrew W. Trites and Rob Williams, University of British Columbia

David E. Bain, University of Washington

John K. B. Ford, Fisheries and Oceans Canada

Examining Temporal and Spatial Variation in Gray Wolf Trophic Relationships Using Stable Isotopes

*Erin J. Urton, Keith A. Hobson and Francois Messier, University of Saskatchewan

AGENDA

Paul C. Paquet, University of Calgary

*Geographical Distribution of the Andean Mountain Cat
and Pampas Cat in the Bolivian Andes*

Lilián Villalba and Nuria Bernal, Colección Boliviana
de Fauna

*An Evaluation of Fisher Reintroductions in Western
Montana*

*Ray S. Vinkey and Kerry R. Foresman, University of
Montana

Intraspecific Fostering in the Red Wolf

William Waddell and Susan Behrns, Point Defiance
Zoo and Aquarium

Christopher Lucash and Scott McLellan, U.S. Fish
and Wildlife Service

*Hand-Rearing Coyote Pups with Commercially Available
Milk Replacers—A Comparison with Mother's Milk*

Krista M. Wenning and Thomas J. DeLiberto, USDA
Wildlife Services

*Artificial Food Sources Alter Distribution and Negatively
Impact the Health of an Insular Canid*

Paula A. White, University of California-Berkeley

*A Coyote in Sheep's Clothing: Sex Identification of Mixed
Species Samples*

Christen Williams and John J. Johnston, National
Wildlife Research Center

*Diets and Habitat Associations of Bush Dogs in Eastern
Paraguay*

Gerald L. Zuercher, Kansas Cooperative Fish and
Wildlife Research Unit
Osvaldo Carrillo, Fundación Moisés Bertoni

*Habitat Associations of Mammalian Carnivores in
Eastern Paraguay*

Gerald L. Zuercher and Philip Gipson, Kansas
Cooperative Fish and Wildlife Research Unit

CONFERENCE EVENTS

Saturday, November 16

Movie Night (Ironwood Room)

7:30 p.m. - 10 p.m.

Join us for a movie night featuring some entertaining wildlife videos.

Sunday, November 17

Field Trip to Big Sur

9 a.m. - 4 p.m.

Wildlife biologists will lead a bus trip down the beautiful California coast and stop along the way to view marine life such as sea otters, seals, sea lions and possibly a few whale species. Stops include Point Lobos State Reserve, Pfeiffer-Big Sur State Park and Andrew Molera State Park. Once in Big Sur, scientists will radio-track endangered California condors and describe the condor reintroduction program. Big Sur is also home to more than 360 species of birds. Bring your binoculars and rain gear. This trip includes transportation and lunch. Buses will depart at 9 a.m., 9:30 a.m. and 10 a.m. Please meet in the DoubleTree Hotel lobby 15 minutes prior to the departure time on your ticket. Note: Some walking will be required. This field trip is organized by the Ventana Wilderness Society. Cost: \$35

Special Session: Education Program (Ironwood Room)

2:30 p.m. - 6:00 p.m.

This special session on carnivore education has two sessions. At 2:30 p.m. there will be a demonstration and discussion of Defenders' new education unit on the southern sea otter. This will be followed by the Wolf Education Roundtable at 4:30 p.m. Wolf educators from around the country will describe their experiences, successes and lessons from their efforts to further wolf education. The roundtable form will encourage participants to share their experiences as well. Anyone involved in education or outreach is welcome to attend.

Icebreaker (Monterey Bay Aquarium)

7:30 p.m. - 9:30 p.m.

The conference will kick off with a dessert reception Sunday night at the world-famous Monterey Bay Aquarium. Come reconnect with old friends and make new acquaintances among the aquarium's wonderful displays. This event is free for registered participants;

please wear your name badge for admission. Spouses may attend for \$25, payable at the door. A shuttle bus will run continually from the main entrance of the DoubleTree Hotel.

Monday, November 18

Silent Auction and Book Signing (DeAnza Foyer)

5 p.m. - 7 p.m.

We'll start the evening with a book signing by well-known wildlife authors and our silent auction. Proceeds from the silent auction will benefit Defenders of Wildlife's The 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. A cash bar will be available during the auction. This event is free for registered participants.

Banquet (DeAnza Ballroom I and II)

7 p.m. - 10 p.m.

Join us for a banquet dinner in the DoubleTree's DeAnza Ballroom. After dinner, we will hear an exciting presentation by Dr. Sylvia Earle, world-renowned scientist and pioneer in the field of marine biology. Cost: \$35

Tuesday, November 19

State Wildlife Manager Session: How To Implement a Living With Carnivores Program (Ironwood Room)

12:15 p.m. - 1:15 p.m.

This unique program provides useful, hands-on information to those working to minimize conflicts with large carnivores around the Pacific Northwest. Learn how state and federal agencies, conservation organizations and private industry partners plan, implement and fund this fully exportable program and learn how to implement a "Living With Carnivores" program in your state.

All Things Mountain Lion (Bonzai Ballroom)

6 p.m. - 8 p.m.

The Mountain Lion Foundation invites everyone who wants to save the American lion to come enjoy hors d'oeuvres and drinks while meeting others on the

battlefront to conserve *Puma concolor*.

IUCN Canid Specialist Meeting (Ironwood Room)

6 p.m. - 8 p.m.

Join canid researchers and advocates for a session of strategizing on canid conservation issues.

Wolverine Conservation Meeting (Cottonwood Room)

6 p.m. - 9 p.m.

This working meeting sponsored by The Wolverine Foundation will focus on the conservation and management of wolverines. The theme is "Wolverine Research: How Far Have We Come and Where Do We Go from Here?"

Wednesday, November 20

Video Presentation (De Anza Ballroom I)

12:15 p.m. - 1:15 p.m.

WildFutures presents *On Nature's Terms*, a 25-minute video demonstrating how ordinary citizens find ways to coexist peacefully with carnivores in both rural and urban areas. A discussion will follow.

Badger Conservation Meeting (Redwood Room)

12:15 p.m. - 1:15 p.m.

Join badger advocates for a session of strategizing on badger conservation issues. Bring your own lunch.

Throughout the Conference:

Exhibit Hall (DeAnza Ballroom III)

More than two dozen conservation organizations and commercial exhibitors will display their services and information in our exhibit hall. The hall will be open from 8:30 a.m.-5 p.m. on Monday and Tuesday and from 8:30 a.m.-3:30 p.m. on Wednesday.

Ambassador Wolf Workshops (Redwood II Room)

Mace Loftus of Reno, Nevada will bring his ambassador wolves, Axel and Atalla, for a small group program 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. Although the cost of the workshop is included in the price of registration, space is limited to the first 200 registrants. Tickets to

an assigned session are included in your registration packet and are not transferrable to any other session.

Art Show

Students from the Art Careers Academy of Monterey High School in Monterey have worked all semester to create wildlife-related art for the conference. Please take time to admire the work of these talented young people—artwork is on display throughout the lobby. A panel comprised of conference art exhibitors will judge the works and present awards at the banquet.

Student Competition

This year, students who have an oral or poster abstract accepted are invited to compete for best student presentation. Student talks and posters will be judged by a panel of experts. Winners will receive a cash prize and be acknowledged on Defenders' website.

GENERAL INFORMATION

CONFERENCE REGISTRATION

All attendees and participants must register for the conference. Anyone not wearing a conference name tag 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 there is no fee.

The conference registration fees are as follows:

Defenders of Wildlife member (memberships available) - \$175 (early) \$190 (late)

Non-member - \$200 (early) \$215 (late)

Full-time graduate or undergraduate student - \$175 (early) \$190 (late)

One Day - \$85 (early) \$95 (late)

Banquet - \$35

Field Trip to Big Sur - \$35

Defenders of Wildlife membership - \$15 (\$5 off regular dues)

CONFERENCE REGISTRATION DESK

Attendees should check in at the registration desk upon arrival at the hotel to pick up their registration packet. This packet includes their name tag, which will admit them to the conference functions, as well as informational materials. Registration hours are as follows:

Sunday, November 17, 8:30 a.m. - 7 p.m.

Monday, November 18, 7:30 a.m. - 6 p.m.

Tuesday, November 19, 7:30 a.m. - 3 p.m.

Wednesday, November 20, 7:30 a.m. - 10 a.m.

CONFERENCE PERSONNEL

The following Defenders of Wildlife staff will be available at the conference to provide assistance:

Aimee Delach and Nina Fascione - Program, Facilities

Gina Schrader - Audiovisual

Melinda Booth - Exhibitors, field trip

Jim Curland - Field trip, volunteers

Sharon Wilcox - Registration

Jenny Neeley - Defenders' Exhibit Booth

Martha Schumacher and Nicole Rivet - Member Services

Phil Rabin and Brad DeVries - Media

NOTICE TO SPEAKERS AND POSTER PRESENTERS

The time your paper is to be presented is listed in this program. The session moderators have been instructed to adhere to the schedule. Please complete your presentation in the designated time allotment so as not to interfere with other activities or to short-change other speakers. Your cooperation is appreciated.

Speakers who will be using slides are urged to bring visuals presorted in a standard carousel. In order to ensure smooth flow of presentations, speakers who are using PowerPoint presentations are encouraged not to use their own laptops. We will create a single CD for each session containing the slide presentations, so please bring your presentation on a disk or other transferrable media.

The Redwood I Room is available to speakers as a preparation room from 9 a.m.-7 p.m. Sunday, 7:30 a.m.-9:30 p.m. Monday and 7:30 a.m.-6 p.m. Tuesday. A slide projector will be available there.

Posters should be set up in the De Anza Foyer between noon-7 p.m. on Sunday and must be removed by noon on Wednesday.

PRESS

Members of the working press and broadcast media (with credentials) must register for the conference but may do so free of charge. There will be a luncheon event for credentialed press on Monday, November 18 at 12:15 p.m. in the Ironwood Room.

GETTING THERE

By air:

The Monterey Doubletree Hotel is easily accessible via Monterey Airport taxis (cost \$10 one-way), or from the San Jose airport, 60 miles from Monterey. Shuttles from San Jose are available for approximately \$30 one way through Monterey Salinas Airbus (831) 883-2871.

By car:

From San Francisco/San Jose Airports and northern California:

Take Highway 101 South to Highway 156 West to Highway 1 South. Exit at Pacific Grove/Del Monte Avenue. Continue down Del Monte Avenue for 1.5 miles, staying in the left lane. Stay to the left past the fork following downtown signs (not going through the

tunnel). The hotel is two blocks up on the right side in Portola Plaza (Right turn off Del Monte Boulevard).

From Los Angeles/southern California traveling on 101 North:

Take Monterey Peninsula Exit which will bring you to Highway 68. Travel on Highway 68 to Highway 1 South. Take the first Monterey exit. Turn right at the first stop light (Camino Aguajito) and continue until it dead ends. Turn left on Del Monte Avenue and stay to the left past the fork following downtown signs (not going through the tunnel). The hotel is two blocks up on the right side in Portola Plaza (Right turn off Del Monte Blvd.).

Parking will be charged at \$12/ day for guests at the hotel. There will be parking in nearby parking lots which cost slightly less.

HOTEL

The Monterey DoubleTree Hotel is the meeting site and overnight room facility for *Carnivores* 2002. The DoubleTree features an onsite restaurant and full bar, a fitness center, heated pool, hot tub and day spa. The DoubleTree hotel is conveniently located near Fisherman's Wharf and Monterey Bay, adjacent to the Monterey Maritime Museum and minutes from Cannery Row, Monterey Bay Aquarium and Carmel-by-the Sea.

SPECIAL ARRANGEMENTS

If attendees are in need of any special arrangements, please contact Sharon Wilcox at 202-682-9400, extension 100.

DRESS CODE/WEATHER

The dress code is business casual for all conference meetings and functions, including the evening events. Monterey weather in November is usually mild, but expect some rain showers.

MONTEREY COUNTY CONVENTION AND VISITORS BUREAU

For those who wish to sightsee, the telephone number for the Visitors Bureau is 888-221-1010 or 831-649-1770 (24-hour automated visitor line).

EXHIBITORS**Steve Oliver**

5200 Hilltop Drive #CC-2
Brookhaven, PA 19015
Featured artist of *Carnivores* 2002

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Academia Book Exhibits organizes and arranges multi-publisher book and journal displays at professional and scientific meetings. A catalog, listing bibliographic and ordering information, is available to participants.

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www.bluedolphin.org

California Wolf Center

P.O. Box 1389
Julian, CA 92036
619-236-9060
www.californiawolfcenter.org

Defenders of Wildlife

1130 17th Street, NW
Washington, DC 20036
www.defenders.org

The Dolphin, Whale and Marine Wildlife Foundation

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Saratoga, CA 95070
www.jojodolphin.org

Endangered Species Coalition

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www.stopextinction.org

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www.polarbearsalive.org

Predator Conservation Alliance

P.O. Box 6733
Bozeman, MT 59771
www.predatorconservation.org

Raincoast Conservation Society

P.O. Box 8663
Victoria, BC V8W 3S2
250-655-1229
www.raincoast.org

Red Wolf Coalition

P.O. Box 2318
Kill Devil Hills, NC 27948
www.redwolves.com

Society for Conservation Biology

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PLENARY SESSION

Ecological Chain Reactions in Kelp Forest Ecosystems

JAMES A. ESTES

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Ecosystem-level impacts of living resource exploitation depend critically on the relative importance of bottom-up vs. top-down forcing. This is especially true in the sea where fisheries have targeted apex consumers and over time have “fished down” the food webs. There is now unequivocal evidence for top-down forcing in kelp forest ecosystems where the depletion of apex consumers has caused phase shifts between kelp beds and sea urchin barrens. In the north Pacific Ocean, these phase shifts followed the depletion of sea otters in the maritime fur trade, and more recently from increased killer whale predation. Killer whales apparently began eating sea otters following the population collapse of Steller sea lions, one of their traditional prey. The ultimate cause of this ecological chain reaction remains uncertain but may relate to historical whaling. Atlantic cod and perhaps other large fishes were the main sea urchin predators in Gulf of Maine kelp forests. Human depletion of these fishes caused a similar phase shift from kelp beds to urchin barrens by the mid 20th century. A sea urchin fishery, which began in 1986, subsequently depleted the urchins, in turn causing a phase shift back to kelp beds. These examples demonstrate the importance of apex predators and top-down control in regulating kelp forest ecosystems. This functional perspective coupled with the analysis of retrospective data suggest that both systems were destabilized by historical overfishing in the open sea.

MOUNTAIN LION CONSERVATION AND MANAGEMENT

Moderator: Lynn Sadler, Mountain Lion Foundation

1. Puma Management in Western North America: A 100-Year Retrospective

STEVEN TORRES¹, HEATHER KEOUGH² AND DEANNA DAWN³

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²*Utah State University
Logan, UT 84322*

³*San Jose State University
Department of Biological Sciences
One Washington Square
San Jose, CA 95192*

Puma (*Puma concolor*) populations have had a diverse and long history of management in western North America. For the most part of the last century, pumas were a bountied predator. By the early 1970s, they had transitioned to game mammal status. In the period since bounties ended, most states and provinces have reported increased puma activity that has been simultaneous with increased human populations and land conversion. We will present an analysis of the political and biological effects influencing puma populations during this period to provide perspective on the potential effects of bounty removals as they may relate to hypothesized increased populations in the latter part of the last century. This presentation will also explore the changing philosophy of predator management and the importance of maintaining predator-prey systems and redefining puma management to include their beneficial role in defining large blocks of habitat and movement corridors.

2. Mystery, Myth and Legend: The Politics of Cougar Management in the New Millennium

RICK HOPKINS

*Live Oak Associates, Incorporated
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San Jose, CA 95119
rick@loainc.com*

The cougar (*Puma concolor*) evokes strong emotions because of its predatory skills, inherently low population density and secretive nature. This skilled carnivore has a mystique that contributes to the polarization surrounding the development of policies for its management throughout North America. Ecologists and wildlife managers are accepting that cougar populations have increased throughout the western United States and Canada. While numbers may have increased in portions of their range over the last two to three decades, the general perception that cougars are more abundant is based on untested word models not empirical data. Cougar management in the 1980s and early 1990s focused more on their impact on prey populations and depredation of livestock more than on direct encounters with humans. An increase in human attacks in the mid-1990s heightened public awareness of cougars. Since 1972, cougars have not been hunted for sport in California, which some argue has contributed to a higher number of attacks or close encounters than in other states. When we transform data regarding human/cougar conflicts (amount of cougar habitat for each state/size of human population/absolute number of attacks) for each of the western states and Canadian Provinces, the greatest number (absolute) of attacks should occur in California and Washington, respectively. However, the observed rate results in California ranking #10 and Washington #6. This information should encourage wildlife managers to sustain large core habitat areas with suitable movement corridors and to focus on educating the public about the relative risk of cougars.

3. Panther Dispersal, Conservation and Recovery Planning

DAVID S. MAEHR¹ AND E. DARRELL LAND²

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566 Commercial Boulevard
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We studied dispersal in 27 radio-collared Florida panthers (*Puma concolor coryi*) in southern Florida from 1986 to 2000. Male dispersal was longer (mean=68.4 km) than that of females (mean=20.3 km) and tended to be circular, frustrated and of insufficient length to ameliorate inbreeding. Females were philopatric and established home ranges that were less than one home range width away from their natal ranges. All females were successful in establishing territories, whereas males were successful 63% of the time. Dispersing panthers avoided moving toward the southeast and into an area of limited forest cover. Independence and the initiation of dispersal occurred at about 14 months of age and lasted for an average of 7.0–9.6 months for females and males, respectively. On average, Florida panthers disperse shorter distances than are typical for western populations of *Puma concolor*. A recent increase in long distance male dispersal events may be related to an increase in reproduction and population density resulting from the introduction of female cougars (*P. c. stanleyana*) into south Florida. Although the population exhibits the behavioral ability to colonize nearby vacant range, females have yet to do so. Successful dispersal to these areas could be facilitated by habitat restoration and translocation of females.

4. Mountain Lions and Endangered Bighorn Sheep: Challenges to Resolving an Apparent Disequilibrium

CHRISTOPHER PAPOUCHIS¹ AND JOHN WEHAUSEN²

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²*Research Scientist
UC White Mountain Research Station
3000 E. Line Street
Bishop, CA 93514*

Mountain lions (*Puma concolor*) and bighorn sheep (*Ovis canadensis*) have co-evolved as predator and prey. Bighorn sheep populations have declined over the past several centuries across their range due to a variety of anthropogenic causes, and have been the subject of extensive translocation efforts in recent years in an effort to re-establish populations in historic habitat. In the past few decades mountain lion predation has also been implicated in the decline of several populations of bighorn sheep, including federally listed populations in the Peninsular and Sierra Nevada Mountains of California and state-listed desert bighorn sheep in New Mexico. This relationship between a native predator and prey does not fit ecological expectations, and restoration of a natural relationship between them presents biological and ethical challenges. We hypothesize that this recent phenomenon has resulted from land and wildlife management practices that have affected both mountain lions and bighorn sheep. We discuss current management efforts, review several hypotheses of how predation might have become a limiting factor for these sheep herds and discuss the implications relative to possible solutions to this conservation dilemma.

5. Living with Lions: Predators and Livestock in East Africa

LAURENCE G. FRANK¹, MORDECAI OGADA² AND ROSIE WOODROFFE³

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²*Mpala Research Centre
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Nanyuki, Kenya*

³*University of California
Department of Wildlife, Fish and Conservation Biology
Davis, CA 95616*

African predators are rapidly disappearing outside of protected areas. Current estimates suggest that there are fewer than 25,000 lions, and many of those are within parks that are too small and isolated to guarantee long-term persistence of populations. As in the rest of the world, predators are killed for preying on livestock. Increasing human and livestock populations, coupled with increasing availability of guns and poison, are responsible for the decline in carnivore populations. However, traditional methods of livestock management evolved in response to the twin threats of predators and human raiders and are quite effective at deterring depredation. These practices are still widespread, both on commercial ranches and in traditional pastoralist areas. Stock are closely herded by day and by night are kept in thornbush corrals (bomas) to prevent them from wandering (people and dogs live in and around the bomas). Most lion depredation occurs at night, when stock stampede out of the bomas in response to the predators' presence. Most hyena depredation occurs when stock are inadvertently left out at night or are stampeded out by lions. Thus, the keys to preventing depredation losses are diligent herding by day and strong boma walls at night. Presence of people, dogs, fires and firearms decrease the likelihood of predator attacks.

In Africa labor is cheap on commercial ranches and free in the traditional areas. Can labor-intensive African anti-predator measures be adapted for use in North America or Europe?

6. Perspectives on the Conservation and Management of Wild Pumas in Western North America

KENNETH LOGAN AND LINDA L. SWEANOR, SCIENTISTS

*University of California-Davis
Wildlife Health Center
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klogan2@mindspring.com*

The puma (*Puma concolor*) is the only large obligate carnivore thriving today in viable populations across western North America. As a keystone species the puma: 1) strongly influences energy flow in ecosystems; 2) is a strong selective force on prey animals; 3) modulates prey population dynamics; 4) indirectly affects herbivory on plant communities; and 5) influences competition between herbivores. Because persisting puma populations depend on expansive, connected wild landscapes with thriving prey populations, the puma is an umbrella species. Puma populations in the West increased in response to legal protections and increasing prey from the 1970s–1990s, but habitat loss and overkill threaten self-sustaining puma populations. Increasing human development reduces wild landscapes and contributes to smaller, more fragmented puma populations, disrupts gene flow and increases risk of extinction. It also increases potential for dangerous puma-human and puma-domestic animal interactions, and thus increases the risk to pumas from lethal control. Overkill of pumas due to sport hunting, control, illegal killing and accidents threatens small populations and can destabilize regional populations and metapopulations. Wildlife managers do not have reliable information on puma population numbers or trends upon which to make scientific management decisions. Instead, puma management seems to take a sledgehammer approach based on uncertainty. To improve puma management and conservation we suggest: 1) adaptive zone management; 2) habitat conservation; 3) long-term research; 4) development of reliable population indices; 5) public education; 6) alternate conservation funding and 7) engaged citizenship.

HUMAN DIMENSIONS OF CARNIVORE MANAGEMENT

Moderator: Martin Nie

1. Top of the Food Chain: American Diet and Lifestyle Activism

JOEL HELFRICH AND SRADDHA HELFRICH

*University of Minnesota
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No other animal has been more thorough and imaginative in harnessing the world's food energy than the human. This paper investigates the ways in which we can integrate political literature that exists regarding man's role in the environment with more biologically based conceptions of carnivores. We examine the role of the most dominant predator — the human being — its impact on nonhuman predators and what we can do personally to mitigate that impact.

Our paper is a call to action — action that is often absent from scholarly presentations and conferences on carnivore conservation and biology. Every one of us possesses a large amount of power and responsibility to make changes for the environment. Every one of us should become activists. We should follow a new kind of activism: lifestyle activism. This type of activism involves being conscious of the products we buy, what businesses or organizations our money supports or how we dispose of our waste. As lifestyle activists, we must pay attention to the all-important votes we are casting with the items we buy and consume. We owe it to our health and the health of nonhuman carnivores around the globe to be aware and to share our knowledge.

2. Endangered Species Act Management of the Western Alaska Steller Sea Lion: Evolution of Interagency Consultation

JEREMY RUSIN

University of Washington
School of Marine Affairs
3707 Brooklyn Avenue, NE
Seattle, WA 98105
jrusin@u.washington.edu

The Endangered Species Act of 1973 (ESA) is the most important piece of environmental legislation ever written. Section 7 of the Act requires that any action authorized, funded or carried out by a federal agency should not jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of its designated critical habitat. Evaluating the effects of direct habitat destruction, as in the northern spotted owl (*Strix occidentalis caurina*) and Pacific salmon (*Oncorhynchus tshawytscha*) cases, is straightforward relative to assessing an action's impacts on prey availability and indirect effects on marine carnivores. The western stock of Steller sea lion (*Eumetopias jubatus*), listed as endangered since 1997, has declined nearly 90% over the last 30 years. Alaska groundfish fisheries for Atka mackerel (*Pleurogrammus monopterygius*), Pacific cod (*Gadus macrocephalus tilesius*) and walleye pollock (*Theragra chalcogramma*) have been hypothesized as possible causes of the decline by creating local depletions of Steller sea lion prey. Local prey depletion may cause nutritional stress in Steller sea lions by decreasing their foraging success during important times of the year. Local prey depletion may also expose animals to increased killer whale (*Orcinus orca*) predation and exacerbate the effects of natural oceanic change on the distribution and abundance of key prey species.

For this paper, six biological opinions written since 1996 were used to illustrate the evolution of Section 7 management through examination of how and to what extent scientific uncertainties have been addressed by research, the effects of litigation on the development on Section 7 management by the National Marine Fisheries Service (NMFS), the role of increased funding in resolving resource management dilemmas and the value of incorporating constituents in management decision-making. This analysis indicates the importance of litigation brought on by environmental groups in the development of Section 7 management under NMFS. However, a closer evaluation of the two most recent biological opinions reveals that NMFS' approach to Section 7 has transformed from reactive to largely proactive. Although the ESA is nearly 30 years old, NMFS' management under the Act is evolving, a sign that the ESA's intricacies, including its flexibility, strengths and limitations, have not yet been fully realized.

3. State Wildlife Policy and Management: The Scope and Bias of Political Conflict

MARTIN NIE

*University of Montana
School of Forestry
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State wildlife policy and management is often characterized by divisive political conflict among competing stakeholders. This conflict is increasingly being resolved through the ballot initiative process. An unprecedented number of wildlife-related ballot initiatives have been voted on in recent years. This paper finds that one important reason why the process is being utilized so often is because state wildlife policy and management decisions are made by state wildlife commissions. These commissions or wildlife boards are often perceived as being biased, exclusive and/or unrepresentative of nonconsumptive stakeholder values. Cases and examples from Alaska, Arizona, Colorado and Idaho are examined in this context. The paper finishes by outlining four broad alternatives that might be discussed or debated in the future: the no change alternative (retaining the state wildlife commission process), the authoritative expert alternative, the structural change alternative and the stakeholder-based collaborative conservation alternative.

4. Attitudes, Knowledge and Education of Residents Toward Mammalian Carnivores Along the Urban-Wildland Interface in Southern California

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The purpose of this research was three-fold: 1) to assess the attitudes of urban residents toward mammalian carnivores; 2) to evaluate the validity of resident knowledge of carnivore distribution by comparing questionnaire responses to field surveys and 3) to test the effectiveness of an educational brochure. Questionnaire surveys indicated that most residents bordering urban habitat fragments in southern California liked to have wildlife in adjacent natural areas and were concerned for their protection. Moreover, the majority of respondents generally favored large carnivore species in adjacent natural areas. Mammalian carnivores are difficult to detect, so consequently many respondents incorrectly believed that carnivores were absent in adjacent natural areas where our field surveys detected them. Residents bordering natural areas appear more reliable about indicating the presence of a species in an area than reporting on its absence. Finally, an educational brochure developed by The Nature Conservancy was issued to 5,000 residents in five cities near the Nature Reserve of Orange County, California. We then sent our questionnaires to 3903 residents in the same five cities. We tested if questionnaire responses differed between: A) residents previously issued a brochure and B) houses located on a street directly adjacent to reserve boundaries. Contrary to expectations, results reveal few differences in responses from residents who received the brochure and those who did not. Further, proximity to reserve boundaries did not affect questionnaire responses. Results suggest that education efforts should be tailored to suit the knowledge and attitudes of the target audience.

5. Large Carnivores and People in Western Wyoming—Where is the Balance?

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This presentation discusses a project that studied human interactions with grizzly bears (*Ursus arctos*), wolves (*Canis lupus*) and cougars (*Puma concolor*) and looked at management systems that influence possible coexistence. Our goal was to contribute to conserving large carnivores sustainably as part of viable regional populations that benefit from broad-based public understanding and action in the common interest. We sought to understand current management and offer ways to improve it. We used an interdisciplinary approach that oriented us to management and policy challenges and ways to improve decisions that determine the fate of these species. In the fall and winter of 2001, we reviewed the last 12 years of newspaper articles and management documents, wrote draft working papers and conducted in-depth phone interviews. During a two-week trip in March 2002, we met with nearly 60 people on all sides of the issue (e.g., ranchers, agencies, outfitters, conservationists, hunters) and attended public meetings. People showed contrasting views in the level and type of conflict they perceived and what actions were needed, ranging from coexistence to elimination of carnivores. People selectively used information to support their outlook. From the ongoing, highly politicized management dynamics, we drew an understanding of the process and possibilities for improvement. We recommend ways that support grounded fieldwork, aid strategic leadership and establish new approaches to understanding and striking a balance between people and large carnivores.

6. Large Carnivore Preservation and Visitor Safety in National Parks: A Balancing Act Through DNA Analysis

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Obtaining information on wild animal populations has been a long-standing logistical problem. However, the ability to detect and analyze animal sign in the wild through non-invasive techniques is becoming an integral part of wildlife research and management, particularly with carnivores, which are generally secretive and costly to capture and study. DNA samples from field-collected hair, tissue and feces can yield insights into the ecology of difficult-to-study creatures such as mountain lions (*Puma concolor*). Through the 1990s, mountain lion attacks, sightings and unusual behavior have been reported with increasing frequency in national parks throughout the west. A three-year study of mountain lions in Grand Canyon National Park is proving that DNA sampling and analysis of genotypes is an effective, low-cost method for detecting and identifying individual mountain lions, kinship and minimum population estimates. This study has provided a framework for other parks in the region with similar habitat types to obtain information about their mountain lion populations that can be used to preserve an integral component of the ecosystem and protect park visitors.

WOLVERINES IN ALASKA, CANADA AND EUROPE

Moderator: Len Ruggiero, Rocky Mountain Research Station

1. Wolverine Habitat Use in a Multiple-Use Landscape Near Revelstoke, British Columbia

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Wolverines are considered “vulnerable” in British Columbia and have been proposed for listing under the Endangered Species Act in the continental United States. Although identifying factors and scales at which wildlife select habitat is important in developing conservation strategies for wide-ranging carnivores, there is little published material on wolverine habitat selection to guide conservation strategies. We used telemetry data from 37 wolverines tracked over six years to assess habitat selection at two spatial scales. The 7,000 km² study area included a variety of land uses including national park land, forest harvesting tenures, two large hydroelectric reservoirs, helicopter skiing operations, snowmobiling areas and a major transportation corridor. Habitat variables considered in the analysis included vegetative, prey distribution and human-use characteristics.

2. Distribution, Density and Harvest Management of Wolverines in British Columbia

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Wolverines are found throughout most of the ecologically diverse province of British Columbia. In spite of the fact that wolverines have been harvested in British Columbia for at least two centuries, a reliable provincial population estimate and an explicit sustainable harvest strategy have never been developed. We use ecological mapping, wolverine ecological research data, ungulate abundance and wolverine harvest data to refine the distribution of wolverines and assist in the development of ecoregional estimates of wolverine density in British Columbia. A spatially based planning model for managing wolverine harvest is discussed incorporating distribution and density, current knowledge and understanding of reproduction and survivorship and aspects of dispersal. We review historic harvest management of wolverines in British Columbia in light of this model.

3. Wolverine Spatial Use Patterns and Habitat Selection in South-Central Alaska

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Wolverines (*Gulo gulo*) are wide-ranging medium-size carnivores that occur at naturally low densities throughout their circumboreal distribution. As opportunistic scavengers, variability in socially mediated, sex-specific selection pressure may result in corresponding variation in wolverine foraging ecology and consequent differences in home range utilization and habitat selection. Further, because of recent conservation concern for wolverine populations in many parts of North America, detailed understanding of factors influencing the spatial ecology of wolverines is needed. We used field-based GPS location data combined with GIS habitat and topographic coverages to test hypotheses regarding sex- and age-specific spatial use patterns and multi-scale habitat selection for a population of radio-collared wolverines in a 6,000 km² study area located in southcentral Alaska. Overall, we found that female wolverines used smaller home ranges (224–1,337 km², n=3) than males (930–1,137 km², n=4), and subadult wolverines tended to have spatial use requirements similar to other animals in their sex class (females: 342–358 km², n=2; males: 913 km², n=1). Preliminary compositional analysis of sex-specific habitat selection indicated that female wolverines used rock outcrop and alpine habitats more frequently than did male wolverines at intermediate spatial scales. We also investigated the influence of topographic features (elevation, slope and aspect) on patterns of wolverine occurrence. Our results document sex-based variation in wolverine spatial ecology and, within the context of other studies, feature insights into wolverine habitat use and home range requirements that enhance our ability to conserve and manage wolverines in northern environments.

4. Population Ecology of Wolverines in Northwestern Alaska

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We have studied wolverine (*Gulo gulo*) ecology within Noatak National Preserve and Kobuk Valley National Park, Alaska since 1996. The project was initiated to gather baseline population parameters to evaluate the impacts of harvest by hunting and trapping. Specific project objectives include survival estimation, harvest assessment, reproductive performance and the testing of prototype satellite-transmitting radiocollars. We have deployed 9 VHF radiocollars, 12 VHF implants, and 9 satellite transmitters on 17 male and 8 female wolverines. Wolverines fitted with VHF radiocollars/implants have provided over 130 locations, but distance to the study area and inclement weather have inhibited consistent efforts to obtain radio telemetry locations at regular intervals. Satellite transmitter performance has been variable, but has provided accurate locations; however, transmissions have been intermittent because satellite signals are impeded when wolverines are presumably in snow/rock caves or dens. Results of analyses of home range and habitat use will be presented. Eleven animals (i.e., 44%) have died because of predation, harvest, starvation or unknown causes. As expected, the harvested wolverine sample (n=137) is male biased (i.e. 66%). Fifteen of 17 (i.e., 88%) females harvested were less than two years old. Examination of stomach contents from harvested wolverines indicates that caribou (*Rangifer tarandus*) are an important part of their diet (i.e., present in 48% of the stomachs). Preliminary isotope analyses of liver, muscle and femur samples from harvested wolverines may indicate seasonal variation in diet.

5. Wolverine Habitat Use on the Central Barrens in the Northwest Territories

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The distribution and habitat use of wolverines (*Gulo gulo*) in the central Arctic of the Northwest Territories and Nunavut is poorly understood. Increasing human activity and development may lead to incremental habitat loss, fragmentation, increased mortality rates and a decline in wolverine abundance. Between 1996–1999, wolverine home range use and seasonal movements were examined within a 2,000 km² area northwest of Lac de Gras. Thirty-six wolverines (15 males, 21 females) were captured and fitted with VHF collars. Estimated wolverine home range sizes were 126 km² for adult females (n=4) and 404 km² for adult males (n=3) using the 95% fixed kernel method. Estimated home range sizes for yearlings ranged from 107 km² to 8736 km². The opportunistic relocation of several collared and ear-tagged individuals provided insight into dispersal patterns and long-range movements. Based on straight-line distance, five females dispersed a mean distance of 133 km (range 69–225 km), while three males dispersed a mean distance of 231 km (range 73–326 km). The longest recorded movement involved a juvenile male collared to the west of Daring Lake and subsequently relocated several months later to the southeast of Great Slave Lake (a distance of 326 km). Some of the challenges of capturing and maintaining collars on wolverines and obtaining sufficient location data necessary to calculate home range size will be discussed.

6. The Role of Infanticide and Reproductive Costs in the Population Dynamics of Scandinavian Wolverines

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The Swedish wolverine population is sympatric with reindeer and distributed along the mountain range in the northwestern part of the country. The population is legally protected, and during 1998–2000, the number of wolverines was estimated to be 326 ± 45 . The main conservation problem is the conflict between wolverines and reindeer husbandry: wolverines prey on reindeer, and as a result, wolverines are illegally killed.

This project aims is to understand the dynamics of the wolverine population in Sweden. During 1993–2002, more than 160 wolverines have been captured and equipped with radio transmitters in the study area.

The average first year survival rate was 0.68 ($n=52$), and intraspecific predation was the main cause of juvenile mortality. The main cause of adult mortality was illegal killing.

Mean dispersal age was 13 months for both males and females. All males and two-thirds of the females dispersed. All sedentary females occupied their mother's territory when she died or shifted territory.

None of the known-aged females ($n=10$) reproduced before the age of 3 years, and the average age at first reproduction was at least 3.4 years. The proportion of adult females reproducing was 0.51 ($n=94$). We found that female wolverine reproduction is influenced by the combined effects of costs from previous reproduction and food availability in winter. The latter was experimentally tested by comparing reproductive success between supplementally fed females and control females.

7. WOLVERINES IN EUROPE: STATUS AND CONSERVATION CHALLENGES

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The wolverine has been characterized as one of the northern hemisphere's rarest and least known large carnivores. General characteristics of wolverine populations are their large area requirements, low densities and remoteness from human developments. Their distribution in the Palearctic is mainly north of latitude 60° and is sympatric with that of reindeer. About 700 wolverines exist in Fennoscandia, most in the northern parts of Sweden and Norway. About 1,500 wolverines live in the Russian part of Europe. The historical distribution of wolverines included areas as far south as Norway and the southern parts of Sweden, Estonia, Lithuania and northeast Poland. Wolverines have small litter sizes and usually do not breed every year and therefore have a relatively low resilience. However, in Fennoscandia, population numbers and distribution have increased overall since they received protection during the 1970s and 1980s. Their distribution and numbers still seem to be decreasing in the Russian part of Europe. Wolverines throughout Fennoscandia are protected and covered by the Bern and Rio Convention and in Sweden and Finland also by the European Union through the Fauna and Flora Directive.

The present conservation problem for wolverines results from their year-round predation on domesticated reindeer in Fennoscandia and unattended sheep during the summer grazing period in Norway. This paper summarizes the current status and main challenges of wolverine management and conservation in Europe.

CARNIVORE CARAVANS: THE LAW AND POLITICS OF TRANSPORTING PROTECTED SPECIES

Moderator: Donald C. Baur, Perkins Coie LLP

1. Species Translocation: Legal and Political Questions

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Some of the most important and controversial actions taken over the last 20 years for purposes of recovering species listed under the Endangered Species Act have involved establishing translocated populations. Because of the unique nature of the law that governs these actions, species translocation puts a premium on consultation, coordination and cooperation among all affected parties. As a result, there is a priority on achieving consensus on species translocations. As a lead-in to the panel discussion on this issue, a brief presentation will be made that highlights the key legal and political questions that must be addressed in undertaking species translocations, with the goal of provoking discussion on whether such efforts produce meaningful benefits and, if so, how to improve the prospects for success in the future.

2. The Endangered Species Act: Legal Context for Transporting Protected Species

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This paper will provide the legal context for the other papers on the panel. It will begin with an examination of the duty to conserve, which is imposed on federal agencies by section 7 of the Endangered Species Act. It will then examine the experimental population provisions of section 10(j), looking briefly at the legislative history, the statutory language and the case law construing the section.

3. Case Study: Translocation of Sea Otters

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This paper will discuss the U.S. Fish and Wildlife Service's Southern Sea Otter Translocation off the southern California coast. The paper will begin with a discussion of the origins and implementation of the otter translocation program. The paper will then discuss the current status of the program and the ongoing review of whether the program should be declared a failure. The paper will also discuss the continuing dispute between conservation groups and the fishing industry. The paper will conclude with a discussion of the lessons that can be taken from the otter translocation program.

4. Background on Section 10(j) of the Endangered Species Act

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Section 10 (j) of the Endangered Species Act provides that "the Secretary may authorize the release (and the related transportation) of any population of an endangered species or a threatened species outside the current range of such species if the Secretary determines that such release will further the conservation of such species" [16 USC § 1539 (j)(2)(A)]. Under the code, the Interior Secretary must also determine if such experimental populations are "essential to the continued existence of an endangered species or a threatened species." This talk will provide background on the "experimental, non-essential designation" under the Endangered Species Act.

5. Howling Success: A Recent Legal History of Reintroducing Wolves Into the Wild

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This paper will examine the federal rules developed by the U.S. Fish and Wildlife Service to release wolves into the Rocky Mountains, the Southwest and North Carolina under Section 10(j) of the Endangered Species Act and other legal authority. The paper will then track the legal challenges to these rules by certain groups and discuss the relevant federal court decisions emanating from such challenges. The paper will conclude with some thoughts on how translocations of this species will be a significant factor in achieving wolf recovery in the United States.

MOUNTAIN LION CONSERVATION: MANAGING CHANGE

Moderator: Michelle Cullens, Mountain Lion Foundation

1. The Status of Mountain Lions in Yosemite National Park

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We monitored the movements of mountain lions (*Puma concolor*) in Yosemite National Park using radio telemetry, track transects and direct observation. We determined that mountain lions frequently pass through developed areas but generally do not linger for any appreciable amount of time. Mountain lion behavior in developed areas largely consisted of either transit from one location to another or, occasionally, hunting. Track transects indicated that mountain lions frequently used trails in Yosemite although encounters with humans were rare. We did not observe any instances of interactions with humans but discuss how repeated exposure to humans raises questions about the potential for habituation.

2. Analysis of Harvest Strategies of Cougars in the Western United States

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In the United States, viable cougar (*Puma concolor*) populations still exist in 12 western states. While sport hunting of cougars remains a management goal for most of these states, there is little information on how different harvest strategies affect their biology. The ultimate goal of this study was to provide insight into the relationship between harvest strategy and population stability. In an effort to better control hunting harvest, several states have shifted strategies from a general hunting season to a more restrictive quota system. We looked at how changes in these strategies affected the size and sex ratio of the harvest. Preliminary results show that, in the past decade, several states have doubled or tripled the number of cougars harvested per year. The average proportion of females in the harvest for all states has risen from 37% in 1990 to 48% in 2000. In states that have banned the use of hunting hounds, the percentage of females in the harvest has risen from an average of 43% to 53%. Additionally, despite an initial reduction in the total harvest, recent totals are comparable to years prior to the ban on hound use. These findings present an interesting dilemma for the management of stable cougar populations.

3. The Management and Conservation of Mountain Lions: Reconciling Science, Public Opinion and Politics

CHRISTOPHER M. PAPOUCHIS AND LYNN MICHELLE CULLENS

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Mountain lions (*Puma concolor*) once ranged throughout the continental United States. However, government sponsored predator eradication programs and alteration of mountain lion habitat resulted in their extirpation throughout most of their eastern range. Today, conservation biologists recognize that the long-term maintenance of viable populations of mountain lions and other top-level carnivores is vital for maintaining ecological integrity and biodiversity. However, despite the invaluable ecological role of carnivores as keystone and umbrella species and changing public attitudes towards native carnivores, the current management of mountain lions continues to be dictated primarily by hunting and agricultural interests. Across most of their remaining range, mountain lions are killed not only for public safety, but also for “sport” and profit, for preying on livestock and pets and for preying on ungulate species, even when these animals represent the lions’ natural prey. However, scientists and wildlife advocates are beginning to explore how management of mountain lions reflects politics and the self-serving tactics of special interest groups rather than the best available scientific knowledge. Questions are also being raised about how value judgements guide and fund wildlife research. We discuss several current management and conservation programs as case studies.

4. Cougar-Induced Indirect Effects: Does the Risk of Predation Influence Ungulate Foraging Behavior on the National Bison Range?

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Ecologists have long debated whether predators (top-down) or nutrients/food (bottom-up) limit prey populations. Evidence supporting the importance of predation is frequently based on the number of prey killed by predators—a direct effect. By examining only this direct effect many predation studies fail to consider behavioral changes arising from the risk of predation—indirect effects. Furthermore, behavioral indirect effects can be more important than the direct effect of predator-caused mortality, influencing both top-down and bottom-up processes. In this study we capitalize on a “natural experiment” on a suite of large mammalian herbivores in a system (National Bison Range, MT) where the behavior and population dynamics of ungulate prey species (whitetail deer, *Odocoileus virginianus*; mule deer, *O. hemionus*; elk, *Cervus elaphus*) can be compared before and after an increase in risk of predation by cougar (*Puma concolor*). We present preliminary data demonstrating that cougars can influence several aspects of prey behavior. With an increase in predation risk, mule deer and elk total daily activity time has declined by 35.9% and 31.8% ($P < 0.05$, ANCOVA) respectively. In addition, deer and elk have reduced their activity levels during crepuscular periods and reduced the use of shrub vegetation which may provide cougar with better stalking cover. We also compare current ungulate habitat use and behavior with concurrent habitat use of resident cougars using radio telemetry techniques. Implications for how the reintroduction of predators may indirectly impact their prey will provide insights for future conservation efforts for large mammals.

WOLF RECOVERY IN CALIFORNIA AND OREGON

Moderator: Nancy Weiss, Defenders of Wildlife

1. Biodiversity of the Klamath-Siskiyou Ecoregion —An Ecoregion In Search of Top Carnivores

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The Klamath-Siskiyou Ecoregion of southwest Oregon and northwest California with its exceptional numbers of plant and animal species has drawn focus from conservationists as an area critical to the maintenance of global biodiversity. Based on species richness, endemism, unique evolutionary and ecological phenomena and habitat-type rarity, the Klamath-Siskiyou is one of the world's most diverse temperate conifer forests. Of 2,377 species from seven groups of terrestrial organisms in the ecoregion (vascular plants, land snails, butterflies, amphibians, reptiles, birds and mammals), 168 taxa are endemic. High levels of endemism also occur in the region's freshwater fish (42%) and freshwater mollusks (60%). Federal or state protective status applies to 154 native taxa, and five terrestrial vertebrates and one fish species have been regionally extirpated. Of the extirpated taxa, three are top carnivores (gray wolf, grizzly bear and the endemic McCloud River bull trout). Approximately 25% of the Klamath-Siskiyou ecoregion's forests are intact but less than half of this intact area is legally protected as wilderness. Most of the wilderness occurs at elevations over 1,500 meters. Over half the federal and state protected taxa are endemic or are found predominantly at elevations less than 1,500 meters, exposing a large percentage of the region's biodiversity to risk of extirpation. Threats to biodiversity in the Klamath-Siskiyou Ecoregion include habitat fragmentation, degradation of species-rich habitats, spread of invasive exotic species and range contraction and extirpation of key species.

2. California Indians and Wolves: An Interrupted Intimacy

MALCOLM MARGOLIN

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As wolves may be making ready to enter California, they are not entering as total strangers. A memory of their former presence lies embedded in myth, language, social systems and artifacts. This paper will tug at pieces of evidence to suggest the ways in which California Indians understood wolves, their character and their role in the world.

3. Wolves and Trophic Cascades in Yellowstone National Park

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Using historical aspen (*Populus tremuloides*) diameter data and aspen increment cores collected in 1997 and 1998, we analyzed aspen overstory recruitment in Yellowstone National Park (YNP) over the last 200 years. We found that successful aspen overstory recruitment occurred on the northern range of YNP from the middle to late 1700s to the 1920s, after which it essentially ceased. We found that aspen recruitment ceased during the same years (1920s) that gray wolves (*Canis lupis*) were extirpated from the park. We hypothesize that wolves may positively influence aspen recruitment through a trophic cascades (top down) effect on elk (*Cervus elaphus*). For prey species such as elk, foraging decisions made under the risk of predation may differ from an optimal foraging strategy based only on maximizing nutrient intake. We suggest that predation risk effects can have a spatially specific influence on elk herbivory at multiple scales. In YNP, elk may have historically avoided foraging in certain aspen and riparian habitats due to the risk of predation from wolves. In 1999, we initiated a long-term study of the influence of reintroduced YNP wolves on elk herbivory and recruitment of aspen as well as other woody browse species found in riparian areas. We found riparian aspen stands in high wolf-use areas had significantly taller aspen suckers than in low wolf-use areas. In addition, in some areas, willow (*Salix sp.*) has been growing taller since wolf reintroduction. This project offers rare empirical evidence on the indirect effects of a top carnivore in a terrestrial food chain and supports theory on predation risk effects and trophic cascades. If the aspen and other riparian vegetation of Yellowstone continue to grow taller and expand in canopy cover, the numerous benefits to ecosystem processes will include stream channel stabilization, flood plain restoration and higher water tables. Through a trophic cascades effect of improved habitat, wolves may be beneficial to numerous species of vertebrates and invertebrates such as fish, birds, beaver and butterflies, as well as many other species of wildlife. Wolf reintroduction may be useful for programs designed to restore riparian areas and biodiversity and should be considered for other areas of the United States, as well as other areas of the world where wolves once roamed. For more information, visit our Wolves in Nature (WIN) website at www.cof.orst.edu/wolves.

4. A Wolf Conservation Center for Northern California Wolf Recovery

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The California Wolf Center was established in the late 1970s as an education and science center focusing on the role of wild canids in North American ecosystems. Today the Center provides three critical services relating to predator conservation including education, reproduction of endangered wolves and scientific research. Two of these three components can play an important role in the recovery of wolves (*Canis lupus*) in northern California and southwestern Oregon.

Education efforts have proven critical to the recovery of wolves in the lower 48 states. Providing accurate, up-to-date information about predators is essential to helping people make their own informed decisions. The California Wolf Center proposes to open an education center in northern California to support these efforts. The model for the new facility will include an exhibit center where people can learn by seeing wolves, hearing presentations and viewing educational artifacts about local wildlife. The center will also establish an outreach program, possibly with traveling wolves, to provide education services in the northern California region where wolves may eventually inhabit.

The California Wolf Center also supports field study and other scientific endeavors relating to the effects of predators on ecosystems. Recently we donated funds to the Yellowstone Wolf Project's winter study. Support for scientific efforts will include raising funds for the study of habitat, predation impacts on the environment and human acceptance.

WOLVERINES IN THE CONTIGUOUS UNITED STATES

Moderator: Jeff Copeland, Idaho Department of Fish and Game

1. Wolverine Conservation: An Integrated Approach

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The U.S. Forest Service has initiated a national conservation program for wolverines (*Gulo gulo*) across their historic range in the lower 48 states under the direction of the Interagency Lynx and Wolverine Steering Committee (ILWSC). This program is an interagency effort that includes federal, state and tribal entities and takes an approach similar to that taken with Canada lynx (*Lynx canadensis*). The framework for this new wolverine program includes: 1) a science assessment to be prepared by a team of research scientists; 2) a program of field research and administrative studies coordinated by the Rocky Mountain Research Station (RMRS); 3) a conservation strategy to be prepared by a team of specialists; 4) development and testing of a field survey protocol and 5) a framework for oversight and implementation under the direction of the ILWSC. The ILWSC meets semi-annually to review progress and provide administrative guidance to the teams responsible for program development. This year the Science Team is scheduled to produce an analysis of historic wolverine records and distribution followed by an assessment of the scientific basis for wolverine conservation. The RMRS has initiated a field research program coordinated with federal, state and private organizations. The Conservation Strategy Team has been formed and will commence strategy preparation as the science documents are received. The RMRS is developing a field survey protocol and field testing will begin this year. A five-year time frame has been proposed for this program.

2. Historical Biogeography of the Wolverine in the United States

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We compiled current and historical records of wolverine (*Gulo gulo*) occurrence in the contiguous United States from published literature, museums, state wildlife agencies, federal resource management agencies and natural heritage databases. Records obtained were of varying degrees of reliability; they included many museum specimens, photos and first-hand accounts of wolverines being trapped (verified records), but were dominated numerically by visual observations of wolverines or their tracks (unverified records). Resulting biogeographic analyses, including assessments of the current and historical distribution of wolverines in the United States, and correlations between elevation and land-cover types varied substantially in accordance with the reliability of occurrence records included in the analyses. Specifically, the geographic distribution of wolverines based only on verified records is much more disjunct and isolated within high-elevation, boreal habitats than is depicted in published range maps. The distribution of verified records also suggests that wolverines have been absent for many years from California, Colorado and the Great Lakes states. We compare inferences resulting from various data sets and discuss the challenges and conservation implications of determining the current and historical ranges of rare and secretive species that have not been surveyed with reliable methods.

3. Efficacy of Lures and Hair Snares to Detect Wolverine

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Resource managers lack an inexpensive and quantifiable method to survey and census wolverine (*Gulo gulo*) presence across large landscapes. Given the low population density and secretive nature of the wolverine, traditional methods such as aerial surveys and remote cameras have limited application because of the high cost of flight time and equipment. Snow track surveys can be effective but are limited to winter periods and are often difficult and dangerous to conduct. None of these methods are always reliable as they can be prone to misidentification and observer bias. As such, error rates are difficult to assess. Lure stations combined with hair snares have provided an empirically tested method for the detection of lynx and should be applicable for wolverine. We tested efficacy of a protocol based on hair snagging to detect presence of wolverine. We measured behavioral responses of captive wolverine to 25 compounds and identified three that elicited abdominal rubbing or rolling. The three candidate lures were tested on a free-ranging wolverine population in Northwest Territories, Canada. We describe the survey sampling design, analysis and results of the captive trials and field tests.

4. Wolverine Distribution and Movements Relative to Landscape Features in the Pioneer, Flint and Anaconda/Pintler Mountains of Southwestern Montana

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Rocky Mountain Research Station, in cooperation with the Western Federal Lands Highway Division of the Federal Highway Administration, initiated research in 2000 to assess the direct and indirect impacts of improvements to the Polaris Road Scenic Byway in the Pioneer Mountains. The emphasis of this research is to understand wolverine movements relative to landscape features, including transportation corridors. Our objectives include: 1) determine the distribution of wolverine, lynx and other carnivores in the Pioneer Mountain Range and adjacent ranges; 2) determine the location and relative frequency that wolverine, lynx and other wildlife (forest carnivores, elk, deer, mountain lions, coyotes and bobcats) use or cross the Polaris road; 3) determine if environmental correlates such as vegetation structure and composition, elevation and landscape physiography are useful predictors of where wolverine, lynx and other wildlife cross the Polaris Road; 4) determine how wolverine movements relate to the Polaris Road and other travel corridors at both fine and broad spatial scales; and 5) determine habitat selection preferences of wolverine, including den site selection, relative to human activity. From 2000–2002, we conducted 8,400 km of snow track surveys on snowmobile roads and trails. Although we only documented one lynx track to date in the Anaconda-Pintler range in 2001, we documented 36 wolverine tracks during the winter of 2000–2001 and 106 during 2001–2002. Wolverine tracks were well distributed throughout the Pioneer, Anaconda and Flint Creek mountain ranges. We also used snow tracking to document that wolverine crossed the Polaris road a minimum of 14 times to date. To study wolverine movements, we trapped and instrumented 5 wolverines (4 males, 1 female) for 350 nights. Trapping will continue for at least two additional years. We are currently monitoring wolverine movements and habitat using aerial telemetry, but we will begin using satellite telemetry to address movement and habitat linkages throughout these “island” mountain ranges.

5. Wolverine Ecology and Management in the Greater Yellowstone Ecosystem, a Program Overview and Update

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Information on wolverine (*Gulo gulo*) abundance, ecology and population dynamics is needed to aid species management decisions and determination of threatened or endangered status. We have selected two sites for intensive study of wolverine ecology in the Greater Yellowstone Ecosystem. Study areas include the Teton Range of northwestern Wyoming and the Madison Range of southwestern Montana. The objectives of this study are to 1) document population status, demographics, and ecology, 2) determine whether human recreation and land-use practices have impacts on wolverine population dynamics and ecology and 3) describe interspecific relationships of wolverines with other species. Since the winter of 2000–2001, we have captured 7 wolverines (3 males, 4 females). One adult male was killed in an avalanche, and one sub-adult female was taken by a recreational trapper. We fitted one wolverine with a GPS collar that he carried for approximately one month. The collar was programmed to obtain one location every two hours, seven days per week. We will present information on GPS collar success: number of locations, quality of locations, percent successful attempts, cost per location, design considerations and collar reliability. This research program is designed as a comprehensive, long-term effort to address specific wolverine management questions and collect information that can be integrated into a landscape species approach to conservation planning in the Greater Yellowstone Ecosystem.

COUGARS, CORES AND CORRIDORS

Moderator: Christopher Papouchis, Mountain Lion Foundation

1. Genetic Structure of Mountain Lion Populations in California and Nevada

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Analysis of microsatellite DNA from 550 mountain lions (*Puma concolor*) revealed contrasting patterns of population structure in California and Nevada. Distinct genetic subdivision was associated with geographic barriers in California, while much of Nevada displayed higher levels of gene flow associated with the north-south orientation of mountain ranges. Levels of genetic variation differed among geographic regions, and mountain lions that inhabited coastal areas exhibited less heterozygosity than those sampled inland. The San Francisco Bay and Sacramento-San Joaquin River Delta, the Great Central Valley and the Los Angeles Basin appeared to be substantial barriers to gene flow, and allele frequencies of populations separated by those features differed substantially. Southern California mountain lion populations may function as a metapopulation; however, human developments threaten to eliminate habitat and movement corridors. While north-south gene flow along the western Sierra Nevada was estimated to be high, future loss and fragmentation of foothill habitat may reduce gene flow and subdivide populations. Preservation of existing movement corridors among regions could prevent population declines and loss of genetic variation. Mountain lion conservation efforts should incorporate landscape-level considerations to protect habitat connectivity, prevent further degradation of regions supporting small populations in danger of collapse and be coordinated across political boundaries.

2. Mountain Lions, Habitat Fragmentation and Wildlife Movement Corridors in Urbanizing Landscapes of Southern California

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Habitat fragmentation is one of the most serious threats to biological diversity worldwide and is especially threatening to wide-ranging mammals such as carnivores. Maintaining landscape connectivity and providing wildlife movement corridors has been supported as one way to help ameliorate these threats. We report on preliminary findings of our research to identify landscape-level habitat linkages and wildlife movement corridors by using mountain lions (*Puma concolor*) as indicators for these connections. Mountain lions were captured and tracked using GPS-linked radio telemetry collars in the Santa Monica Mountains, Simi Hills and Santa Susana Mountains of Ventura and Los Angeles Counties. Information on mountain lion distribution and movements are now being assessed in combination with other carnivore studies to evaluate fragmentation impacts on wildlife. Through our work, we hope to identify critical movement corridors, evaluate corridor restoration opportunities and gain further insights about how mountain lions can live in parks along the rapidly developing urban interface of southern California.

3. Influence of Vegetation, Roads and Urbanization on Cougar Habitat Use and Movement

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Understanding the impact of habitat fragmentation, roads and other anthropogenic influences on cougars (*Puma concolor*) requires quantitative assessment of habitat selection at multiple scales. Using a fixed kernel estimator, we calculated home ranges for 13 adult female and 2 adult male radio-tagged cougars monitored October 1986–December 1992 in the Santa Ana Mountain Range of southern California. We used compositional analysis to assess diurnal use of vegetation types and areas near roads at two orders of selection (second-order: locations within the study area and third-order: locations within the home range). At both orders of selection and across seasons, cougars preferred riparian habitats and avoided human-dominated habitats. Although cougar home ranges tended to be located away from high- and low-speed two-lane paved roads (second-order avoidance), cougars did not avoid paved roads within the home range (third-order), especially when the roads were in preferred riparian areas. Additionally, we examined travel paths of 10 female and 7 male cougars monitored during 44 nights of hunting. Cougars spent a disproportionate amount of time in preferred vegetation types, traveling slowest through riparian habitats and fastest through human-dominated areas. Paved roads inhibited and dirt roads facilitated cougar movements. Protecting habitat mosaics that include riparian areas and keeping paved roads out of riparian areas are critical to the conservation of this cougar population.

4. Cougar Exploitation Levels in Utah: Implications For Demographic Structure, Metapopulation Dynamics and Population Recovery

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Currently, 11 states and 2 Canadian provinces utilize sport hunting as the primary mechanism for managing cougar (*Puma concolor*) populations, but the impacts of sustained harvest on demographic structure and population persistence are not well understood. Because cougars are difficult to enumerate in a cost-effective manner, calculating sustainable harvest levels across heterogeneous landscapes may not be feasible. We have been monitoring the cougar populations on Monroe Mountain in south-central Utah and in the Oquirrh Mountains of north-central Utah since 1996 and 1997 respectively. The critical management distinction between these two sites is the degree of exploitation. The Monroe population is subjected to heavy annual hunting pressure and is characterized demographically by a younger age distribution, low survivorship and declining fecundity and density. In contrast, the population inhabiting the northeastern slope of the Oquirrhs is subjected to little or no hunting pressure and exhibits an older average age distribution, relatively high survivorship and fecundity and stable density. Due in part to these differences, the Oquirrh and Monroe populations appear to exhibit source and sink dynamics within the regional metapopulation. Therefore the temporal scale of population recovery may depend on the interaction between the dominant management regime and the degree of connectivity with neighboring habitat patches. We discuss the implications of these demographic distinctions in light of management uncertainties, differential vulnerability and landscape structure.

5. Using Analysis and Modeling of Individual-Based Mountain Lion and Bobcat Movement to Assess Landscape Connectivity in the Southern California Ecoregion

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The southern California ecoregion has been severely impacted by urban and agricultural development, yet assessments of the functional connectivity of the present landscape and possible future landscapes in this region are lacking. These assessments would allow conservation organizations and resource agencies to take proactive steps to preserve habitat linkages in this fragmented system. Since connectivity is an interaction between landscapes and animal movement, models of movement on heterogeneous landscapes may be useful tools for making assessments. We outline a research project focusing on the analysis and individual-based modeling of mountain lion (*Puma concolor*) and bobcat (*Lynx rufus*) movement on geographic information system representations of the southern California landscape. Because mountain lions require large core areas of habitat and are particularly sensitive to fragmentation, they are excellent indicators of connectivity at the ecoregion scale. Bobcats are less sensitive to fragmentation and are excellent indicators of connectivity at smaller spatial scales. We will develop new techniques to analyze movement data, use these techniques to analyze radio telemetry data from mountain lions and bobcats, construct individual-based movement models based on the results of the analysis and use these models to assess landscape connectivity in the southern California ecoregion. Our movement models will allow us to identify and design movement corridors for mountain lions and other species and help protect landscape connectivity in southern California.

6. Using Cougars To Design a Wilderness Network in California's South Coast Ecoregion

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The groundbreaking “Missing Linkages” report published in fall 2001 (www.calwild.org/resources/pubs/linkages/index.htm) identified over 200 linkages needed to prevent isolation of wildlands in California. South Coast Wildlands Project (SCWP) immediately spearheaded an effort to prioritize, protect and (where necessary) restore linkages in the South Coast Ecoregion. Using three carnivores as our umbrella and flagship species, puma (*Puma concolor*), bobcat (*Lynx rufus*) and steelhead trout (*Oncorhynchus mykiss*), SCWP first assessed the ecoregion’s 69 linkages with respect to biological irreplaceability (size and quality of core areas served by a linkage were important criteria) and vulnerability (to urbanization and roads). This process identified 14 linkages as top priorities. We are now organizing a series of action workshops for each linkage. At the first workshop, local biologists, government agency and conservation NGO representatives will develop lists of focal species and ecological processes that a linkage is intended to serve. Thus, although carnivores help identify important linkage areas, we will design the linkage to serve broader biodiversity goals. Our personnel will then research the needs of the focal species, obtain high-resolution photographs and parcel maps, conduct field visits, and present one or more linkage designs at a second workshop four to six months later. At the final workshop, participants will volunteer for various tasks (e.g., procuring easements, acquiring land, changing zoning, restoring habitat, or mitigating transportation projects) to preserve and enhance the linkage. By partnering with agencies and NGOs from the start rather than developing a plan on our own and asking others to unite under us, our effort has attracted funding and cooperation from diverse sources and is making rapid progress.

CONFLICTS WITH AGRICULTURE AND OTHER WILDLIFE

Moderator: Suzanne Laverty, Defenders of Wildlife

1. Predicting Human-Carnivore Conflict: A Spatial Model Based on 25 Years of Wolf Predation on Livestock

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Many carnivore populations escaped extinction during the 20th century because of legal protections. However, carnivore attacks on livestock and encounters with humans are increasing in some areas, raising concerns about the risks and costs of carnivore conservation. We present a method for predicting sites of human-carnivore conflicts in order to prevent them. We identify consistent attributes of sites where wolves have attacked livestock over the past 25 years across an area of 46,000 km². We construct a spatial model and risk map to guide interventions. Our approach can be applied wherever spatial data are available on sites of conflict between wildlife and humans. We also discuss experimental findings on the effectiveness of nonlethal techniques in deterring wolves from entering fenced enclosures containing livestock.

2. Coexisting with Carnivores: Community-Based Approaches to Agricultural Conflicts

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Livestock predators in the United States have traditionally been managed by the Department of Agriculture's Wildlife Services (WS) program through cooperative agreements with states, counties, municipalities and other entities. Wildlife Services relies heavily on lethal methods in management efforts directed at coyotes and other native carnivores. Public opposition to lethal control, however, along with biologists' increased understanding of the ecological importance of native carnivores has lead to greater demand for humane, socially acceptable and ecologically-sound management methods.

In 2000, after four years of public controversy over the taxpayer-subsidized killing of native carnivores by WS, Marin County, California, established a groundbreaking program that has garnered national recognition. The five-year Strategic Plan for Protection of Livestock and Wildlife phases out subsidized lethal predator control methods and provides \$50,000 annually to assist qualified ranchers in implementing nonlethal techniques (e.g., guard dogs, llamas, frightening devices and improved fencing) and a county cost-share indemnification program to compensate ranchers for verified livestock losses resulting from predation.

This presentation discusses how the community-based program: 1) offers an effective, cost-efficient and ecologically sound livestock protection program while allowing native carnivores to remain on the land; 2) involves cooperation among ranchers, the County Agricultural Commissioner's office and various community organizations; and 3) meets the needs of both the ranching and wildlife conservation communities by offering an alternative to federally subsidized lethal predator control.

3. Cougars and Desert Bighorn Sheep in the Fra Cristobal Range: Adaptive Management of Predation

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Desert bighorn sheep (*Ovis canadensis mexicana*), a state endangered species, were translocated to the Fra Cristobal Range of south central New Mexico during 1995 (N=37) and 1997 (N=7). Predation by cougars (*Puma concolor*) has been the largest source of mortality for this population (March 2002 N=72). Beginning in 1999, our management goal was to establish a viable population of sheep while determining an optimal strategy for managing cougars. A second objective was to maintain an intact predator-prey system. We used an adaptive management approach because the replication and randomization of treatments necessary for a rigorous scientific experiment were not feasible. We radio-collared most cougars (N=10) that entered sheep habitat. We observed cougar movements and behavior, seeking patterns that would enable us to predict which would prey repeatedly on sheep. Riflemen on foot were able to kill radio-collared problem cougars (N=4) in a couple days when necessary. Some cougars never preyed on sheep (N=3), and others committed only one depredation (N=3). We saw some evidence that removing female cougars could actually increase predation in the short-term. The removal of a resident female from sheep habitat seemed to elicit a male searching response resulting in increased depredation. We recommend that cougar removal decisions be made on a case by case basis not as regional one-size-fits-all management paradigms. For a modest cost, outcomes of each decision can be monitored and used to fine-tune future decisions.

4. The Southern Alberta Conservation Cooperative: Working with Ranchers To Reduce Conflicts with Wolves

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The Southern Alberta Conservation Cooperative is a practice-based research program of the Central Rockies Wolf Project. Our primary goal is to reduce conflicts between livestock producers and wolves (*Canis lupus*) in southern Alberta. We work closely with livestock producers to develop and test depredation avoidance techniques. This paper summarizes depredation patterns in southern Alberta since 1990 and compares these patterns to those in Montana, Wyoming and Idaho. We also summarize our testing of fladry (flags hanging from ropes) as a depredation avoidance tool under conditions where cattle are confined to a relatively small area.

5. An Adaptive Strategy for Nonlethal Management of Wolves in Idaho

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With the reestablishment of wolves in the western United States, managing adverse interactions between wolves and livestock is an important issue for both wolf recovery and protection of livestock. Lethal control of wolves is generally unfavorable; however, there are very few nonlethal tools or techniques that managers can use to minimize conflicts. In response to the need for more nonlethal tools, we developed and are testing a behavior contingent system for disrupting predation events. The Radio Activated Guard is activated by signals from nearby wolf radio collars. The strobe light, tape player with 30 different recorded sound effects and behaviorally contingent activation are designed to minimize habituation to the system. We describe how Radio Activated Guards work and report results from ongoing studies in Idaho, demonstrating the effectiveness and limitations of the scare device. Benefits of Radio Activated Guards include fewer livestock killed resulting in fewer wolves killed, unattended protection of pastures and alerting producers. Limitations of the scare device include eventual habituation to the device, electronic complexity, area coverage and price. We continue to develop and test Radio Activated Guards at study sites in Idaho and Wisconsin.

6. “Cultural Carrying Capacity” vs. Coexistence With Carnivores

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The thresholds of tolerance by humans for carnivores is often referred to collectively as the “wildlife acceptance” or “cultural carrying capacity.” In many cases the biological carrying capacity can support more carnivores, but the number of carnivores that can coexist compatibly with humans is inhibited by negative human attitudes. The willingness of humans to coexist with wildlife is often used by wildlife agencies to determine the number of carnivores that can successfully occupy a habitat. Several agencies regard “perceived threat” as a legitimate construct defined by “cultural carrying capacity” and consider it equal to “biological carrying capacity” when designing a predator control program.

Efforts to recover and reintroduce declining carnivore species into an ecosystem often initially receive a high level of enthusiasm. But when the population increases in response to protection efforts, hostile demands to reduce or eliminate the same carnivores mount.

Certainly carnivores can pose some threat to livestock and on rare occasions to humans, but management should not be based upon perceived or unfounded fears. We question why some agencies have increased lethal methods and even returned to the antiquated use of the bounty in spite of current knowledge about carnivores.

We will argue that management needs to do more to increase the willingness of humans to coexist with predators, consider the opinions of those who do support carnivore protection and strive for functional ecosystems that include carnivores.

FOXES

Moderator: Gary Roemer, New Mexico State University

1. The Foraging Behavior and Conservation of the Critically Endangered Island Fox

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We examined seasonal patterns of habitat use in a solitary foraging, facultative insectivore, the island fox (*Urocyon littoralis*). Seven social groups of foxes inhabiting a coastal grassland mosaic on Santa Cruz Island were followed nightly, at nearly monthly intervals, between November 1993 and December 1994. This procedure resulted in 6,204 telemetric fixes, 64.8% of which represented actively foraging foxes. We also measured seasonal changes in body mass (n=280), assessed food habits through scat analysis (n=145), measured seasonal abundance of their principal prey and quantified habitat structure in randomly stratified 1-m² plots (n=325). Habitat distribution was mapped on site and the proportion of habitats available to a foraging fox were determined from a habitat map generated in a GIS framework. The number of telemetric locations for each fox occurring within each habitat type was determined when each fox was followed. Patterns of proportional habitat use were elucidated by compositional analysis. Foxes appear to utilize habitats with moderate to high prey abundance and sparse cover. Habitats with high prey abundance and dense cover were used less frequently than available. Habitats used more than expected consisted primarily of native habitats whereas habitats used less than expected primarily consisted of dense mats of exotic annual grasses. We further hypothesize that the proliferation of exotic annual grasses following the removal of grazing herbivores may be reducing carrying capacity and contributing to the decline of foxes on some of the California Channel Islands.

2. Island Fox Recovery Program on the Northern Channel Islands, California

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In 2001, the U.S. Fish and Wildlife Service proposed to list as endangered the three subspecies on the northern Channel Islands, as well as the Santa Catalina Island subspecies. Island fox (*Urocyon littoralis*) populations on the northern Channel Islands declined by 95% from 1995–2001 because of predation by golden eagles (*Aquila chrysaetos*). Golden eagles never bred historically on the islands but are currently supported by an alien prey base, feral pigs and the absence of breeding bald eagles (*Haliaeetus leucocephalus*), which were extirpated by the mid-20th century. In 1999, the National Park Service began implementing recovery actions for island foxes on the northern Channel Islands, based upon recommendations from a panel of experts. These actions included the live capture and removal of 22 golden eagles from the Channel Islands between 1999 and 2002 and the initiation of captive breeding in 1999 to increase the critically low fox populations. San Miguel and Santa Rosa, the two islands with no wild foxes, have increased from a captive founder population of 14 to 28 foxes on San Miguel and from 16 to 45 foxes on Santa Rosa. Initial releases back into the wild may begin in fall 2002. Demographic modeling was used to determine target population parameters and an augmentation schedule for an island fox recovery plan. Recovery of wild fox populations to viable levels are expected to take about a decade.

3. Endangered San Joaquin Kit Fox and Non-Native Red Fox: Interspecific Competitive Interactions

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We investigated the interference and exploitation competition between two species of fox: the endangered native San Joaquin kit fox (*Vulpes macrotis mutica*) and the non-native red fox (*Vulpes vulpes*). Seven kit foxes and 16 red foxes were radio-collared and tracked via radio telemetry near Lost Hills, California. Home range overlap occurred between the two species; however the activity cores of the individuals did not overlap, indicating that spatial partitioning was occurring. One kit fox was killed, but not eaten, by a red fox, indicating interference competition. Coyotes were the main cause of death for both species of fox. The presence of both the red fox and coyote in kit fox ranging areas may present a negative additive effect on the survival of the kit fox. The employment of mechanisms such as year-round den use by kit foxes may allow coexistence between kit foxes and coyotes but not necessarily red foxes.

4. Resource Partitioning and Interspecific Competition Between Coyotes and Red Foxes on an Island During Recent Colonization by Coyotes

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Red foxes (*Vulpes vulpes*) were the primary mammalian predator on Mount Desert Island, Maine, until coyotes (*Canis latrans*) colonized the island in 1981. The recent establishment of coyotes on Mount Desert Island may have caused changes in habitat use and distribution of red foxes resulting from interspecific competition. To assess evidence of resource partitioning and interspecific competition between sympatric coyotes and red foxes, we examined the spatial associations and overlap in diet and habitat use between the two species. Overlap in habitat use was high between foxes and coyotes and was likely the result of selection for mature forest types by both species. The primary prey of both coyotes and foxes during summer included white-tailed deer, small mammals and fruits. High interspecific food overlap between coyote and foxes provides indirect evidence for competition, and indicates a potential for exploitative competition. Foxes on Mount Desert Island were associated with higher elevation areas that lacked coyote core territories and positioned home ranges outside of coyote territories. Based on our results of high dietary and habitat overlap and spatial avoidance of foxes by coyotes, we believe there is evidence to suggest both exploitative and interference competition between these canids.

5. A Case Study in Evaluation of Carnivore Conservation Efforts: The Blackfeet Swift Fox Reintroduction Program

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Despite frequent references to adaptive management and the importance of evaluating conservation programs, independent review of such efforts is rare. Moreover, many conservation programs fail to develop clear measurable objectives, monitor their progress and change course when necessary. Thus, improvement in the status of rare and endangered species may be impeded and may not be cost-effective. The Sand County Foundation, an NGO conducting and promoting science-based habitat management, asked the authors to conduct an independent peer review of The Blackfeet Swift Fox Reintroduction Program. Sand County, through the Bradley Fund for the Environment, had supported this program since 1998, which involved a partnership between three private institutions, Defenders of Wildlife, the Cochrane Ecological Institute and the Blackfeet Nation. We describe the process used to conduct the review and some of the results. Diverse stakeholders in swift fox conservation, within and outside the Blackfeet program, were interviewed using a standardized questionnaire. Interviewees were asked about the program's objectives and goals, measures of success, organization and structure and other issues and asked to give their opinion concerning the major achievements and limitations of the program. The authors also conducted a site visit. The results and recommendations, summarized in a report, included a need for more coordination, internal and external communication, swift fox monitoring and resources. It is noteworthy that the review process itself acted as an intervention and resulted in program changes prior to the completion of the final report.

6. Measuring the Abundance of an Elusive Carnivore: The Red Fox in Northeast Ireland

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The red fox (*Vulpes vulpes*) is a widespread and adaptable carnivore. It can be an important predator of vulnerable species and as such there is a need to understand the population dynamics of this species in the environment. It can be difficult to obtain reliable density estimates of this species because of its secretive nature and nocturnal habits which can be an impediment to conservation and management strategies.

We report a study which has aimed to establish the relative abundance of foxes in four large regions (188–341 km²) of Northeast Ireland—two upland (>150m) and two lowland (<150m). Animals were counted during spring (pre-breeding) and autumn (post-breeding) 2000–2001 on established transects in each area. Transect length varied from 80–100 km. Surveys were carried out at night and lasted between five and seven hours. Data analysis and survey design followed distance sampling techniques.

We found variation in the abundance of foxes between transects and survey sessions. Spring abundance was highest in lowland regions (0.6–1.6/km²) compared to upland regions (0.3–0.4/km²). This was also reflected in autumn counts wherein lowland density estimates were three to four times higher than in the uplands and reached a maximum of 3.6/km². The observed differences in abundance were persistent from season to season and year to year suggesting both robustness in the method and a degree of population independence at the geographical scale of investigation.

The estimates of population density obtained were rapid, repeatable and relatively cheap to achieve. As such the method may be relevant for other monitoring strategies.

WOLF RECOVERY AND BIOLOGY (I)

Moderator: Edward Bangs, U.S. Fish and Wildlife Service

1. Changes to the Status of the Gray Wolf Under the Endangered Species Act

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Based upon increasing gray wolf (*Canis lupus*) numbers and range expansions, the U.S. Fish and Wildlife Service proposed in July 2000 to reclassify several gray wolf populations from endangered to threatened under the Endangered Species Act. In recognition of varying degrees of progress toward recovery goals, FWS proposed listing the gray wolf as four separate Distinct Population Segments. Three of the DPSs would be “threatened,” and the fourth would remain “endangered.” Following that proposal FWS reviewed comments, analyzed new data, reconsidered regulations and policy, and subsequently made a final decision on the proposed changes. FWS’s final rule and associated regulatory changes for the gray wolf are described and changes from the proposal are explained. Future FWS gray wolf recovery efforts and classification changes also are discussed.

2. Gray Wolf Restoration in the Northwestern United States

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Gray wolf (*Canis lupus*) populations were eliminated from the western United States by 1930. Dispersing wolves from Canada lacked legal protection until passage of the federal Endangered Species Act (ESA) in 1973. By 1986, a pack had naturally formed in northwestern Montana. Wolves in that area were reclassified to threatened status in 2002. In 1995 and 1996 wolves from western Canada were reintroduced to remote public lands in Idaho and Yellowstone National Park, Wyoming. Wolves were designated as experimental populations to increase management flexibility. Wolf population growth has occurred rapidly because of the reintroduction. About 563 wolves in 34 breeding pairs were present in December 2001, and the wolf population has a young age structure with the potential for continued rapid expansion. The wolf population in the northwestern United States should meet the recovery goal of having 30 breeding pairs distributed throughout Montana, Idaho and Wyoming for three successive years by December 2002. If Montana, Idaho and Wyoming have state wolf conservation plans in place, wolves could be proposed for delisting from the ESA in 2003. Wolf restoration has proceeded more quickly and with more benefits (public viewing) and fewer problems (livestock depredations) than predicted. The impact of wolf predation on big game (primarily elk) populations is a major public concern. Several cooperative research projects have yet to detect significant impacts to wolf prey but these ongoing studies will provide accurate information to address public and agency concerns. Because over 85% of adult wolf mortality is human-caused, the inter-agency recovery program focuses its efforts to increase the tolerance of people who live near wolves. Wolves restored important ecological processes to several large wild areas in Montana, Idaho and Wyoming. The program has been widely and internationally publicized and is generally viewed as highly successful.

3. Mexican Wolf Recovery: Status, Three-Year Review and Current Challenges

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After decades of captive breeding and many years of public process, captive-reared Mexican gray wolves (*Canis lupus baileyi*) were reintroduced to the wild in south-central Arizona in March 1998. After initial setbacks from human-induced mortality, as of May 2002, the free-ranging reintroduced Mexican wolf population consisted of a minimum of 17 individuals in 7 breeding groups. Major milestones to date include the recruitment into the population of wild conceived offspring and breeding pairs forming on their own—both significant signs of a transition to a naturally functioning free-ranging population. During the 2002 whelping season, we anticipate that the second generation of wild conceived pups will be born.

In 2001, an intense scientific and stakeholder review of the program was completed. The process used and summary findings of this review will be discussed. Among the biggest challenges to sustaining this success and recovering the Mexican wolf is the current requirement to implement management actions on wolves that leave the designated wolf recovery area and are not a problem. Extraordinary financial and logistical resources have been expended to recapture such wolves. The ability to establish wild wolf behavior in reintroduced captive-born wolves is the foundation on which Mexican wolf recovery is being built. However, it is noteworthy that to date, a minimum of 16 of the 69 wolves released from captivity survive in the wild. This success rate exceeds that of any other canid reintroduction using captive animals as reintroduction stock. Other challenges and needs necessary to recover the Mexican wolf include: additional reintroduction area, a revised recovery plan, a sustained effort at the field level to capture and mark wild-born wolves, public support at the national, regional and local level and sustained funding. The options available and efforts underway to address the challenges and needs of Mexican wolf recovery will be discussed.

4. Adaptive Management of Red Wolves in Northeast North Carolina

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We report good progress in managing the world's only wild red wolf (*Canis rufus*) population. Red wolves were restored to northeast North Carolina in 1987 when coyotes (*Canis latrans*) were not present on the Alligator River National Wildlife Refuge. In 1999, an adaptive management plan was developed to address the threat of dilution of the red wolf gene pool caused by interbreeding with coyotes entering the red wolf experimental population area. Red wolves, coyotes and coyote/wolf mixes are managed effectively across a five-county area comprising approximately 1.5 million acres. The red wolf population is expanding, while the number of coyote/wolf hybrid adults are controlled and reduced. The number of mixed coyote/wolf litters is reduced and limited to only the western edge of the experimental population area where such litters are expected. Due to success in implementing the red wolf adaptive management plan, red wolf management zone boundaries are being expanded westward.

5. Growing Pains: Learning to Live with a Growing Wolf Population

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Wolves are on their way to delisting. This brings up many new challenges for wolf advocates and managers. In the past 50 years wolves, have existed in such low numbers that only the question of recovery was being discussed. Now that wolves are going to be considered by law to be recovered, managers and advocates will have to redefine how wolves will become part of daily life in many parts of the United States.

Wolf advocates face many challenges in this changing political landscape. Will wolves be able to live everywhere that is biologically feasible, or will we need to create wolf-friendly zones? How do we decide when wolves are causing too many problems for humans that is in everyone's best interest to remove them? Does an animal, especially one with complex social behaviors, change fundamentally when it is forced to live in limited areas and is constantly subject to culling by its human neighbors? Managers of wolves will be attempting to balance the biological and social behavior of wolves and our society's concept of living with large carnivores. Wolf advocates may find themselves shifting from promoting wolves absolutely to minimizing conflicts where possible.

These are the kinds of issues that residents of the new wolf range, wildlife advocates and wildlife managers will face as wolves repopulate greater areas of the United States. This talk will explore these issues based on discussions with wolf advocates, researchers and managers across North America.

6. Landscape-Level and Within—Territory Habitat Selection of Recolonizing Gray Wolves in Northwest Wisconsin

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We used compositional analysis to examine habitat selection by wolves (*Canis lupus*) in 15 pack territories established between 1992 and 1999 in northwestern Wisconsin. Land-cover vegetation type and land ownership were analyzed at landscape and within-territory levels. Forested wetland, lowland shrub, and aspen were the three most highly selected cover types at the landscape level while agriculture, shrubland and jack pine were the three least selected cover types. Within territories, forested wetland, aspen and oak were the most selected cover types, while mixed/other coniferous, maple and grassland were the least selected. County land was the most selected and private the least selected ownership category at the landscape level. We also determined the proportion of the total area of territories within arbitrarily defined buffers (25, 50, 100 and 250 m) along roads and compared this to the proportion of wolf locations within these buffers to examine use of areas in proximity to roads. The proportion of locations within all four buffer categories was lower ($p=0.001, 0.067, 0.041, 0.033$ respectively) than the proportion of available habitat, indicating avoidance of areas around roads. We hypothesize that avoidance of human disturbance and the habitat preferences of prey species may drive territory selection at the landscape level and habitat use within territories.

MESOCARNIVORES

Moderator: Caroline Kennedy, Defenders of Wildlife

1. Multi-Scale Habitat Selection by American Martens in the Coastal Forests of Northwestern California

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The distribution of American martens (*Martes americana*) has declined within the coastal forests of the Pacific states, with the most severe decline within the historical range of a recognized subspecies, *M. a. humboldtensis*, in northwestern California. Currently only a single population occupying less than 5% of its historical distribution is known to remain. This population became the focus of a multi-scale habitat selection study, the first investigation of habitat ecology of martens in Pacific state coastal forests. A random, systematic grid with 2-km spacing was used to identify 159 forest stands to be surveyed across the region where the population was known to occur. A two-station track plate sample unit was established in each stand and run for 16 consecutive days. Habitat models were developed at three spatial scales relevant to martens: stand, home range and landscape. Habitat models were compared (using AICc), within and between scales to determine scale specific predictors of marten occurrence. The results of these analyses will be presented with specific emphasis on their application to the conservation of martens in coastal northwestern California and to the understanding of the habitat ecology of martens.

2. Predicting Habitat Supply for American Marten Using Measures of Landscape Composition and Configuration

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The American marten (*Martes americana*) is the most area-sensitive, forest-specialized mammal inhabiting forest landscapes in northern Maine. We developed models to predict marten habitat supply in northern Maine using 124 adult marten home ranges and 98 simulated unoccupied home ranges from north-central Maine. Year-specific habitat maps were generated separately from Landsat Thematic Mapper satellite imagery. Six landscape metrics were calculated. The information-theoretic approach was used to rank 30 *a priori* logistic regression models. Model predictions were tested against additional field data (n=127 occupied and 41 unoccupied home ranges) to assess each model's predictive capability. The top-ranked model, containing four variables (the proportion of suitable habitat, patch density, patch size variability and the interaction of patch variability and density) correctly predicted 70% of our model build data and 72% and 100% of our independent data sets. The proportion of the home range in suitable habitat was the most important single variable in predicting marten presence or absence. However, our highest-ranking models included at least three variables measuring landscape configuration, indicating that landscape shape and configuration are important determinants of habitat supply for marten. Our top-ranked model was used with habitat maps based on 1993 and 2000 satellite imagery to predict habitat supply across the marten's range in Maine and to estimate changes in habitat supply and marten density. While our overall density estimates declined only slightly between 1993 (5,561 males; 8,800 females=14,361 total) and 2000 (5,778 males; 8,197 females=13,975 total), the difference in trend for males (+) and females (-) indicates that the change in the amount and spatial arrangement of habitat had the opposite effect for each sex. Our results indicate that natural resource managers should consider both the amount and spatial configuration of suitable habitat when managing forest landscapes.

3. Distribution and Co-Occurrence of Mesocarnivores in the Central and Southern Sierra Nevada

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To describe the patterns of variation in the number and identity of coexisting mesocarnivores, I analyzed presence-absence data at 177 sample units (1,059 track stations) in the central and southern Sierra Nevada with particular reference to the fisher (*Martes pennanti*), a species that has experienced declines in the Sierra Nevada and persists only in the southern portion of the study area. Local assemblages were compared to the regional species pool, random distributions and random assemblages. Patterns of co-occurrence based on body size were also examined. In general, local assemblages were highly variable; each species occurred with many other species and in many different combinations. Species occurrence patterns were compared between areas where fishers persist and where they are absent. Several species occurred less frequently in areas where fishers persist. Although additional data are needed to identify the mechanisms responsible for the observed patterns of occurrence in the mesocarnivore community, the data presented suggest some level of structure in the observed assemblages. Possible explanations for the observed patterns and their relevance to carnivore conservation are discussed.

4. Integrating Rare Carnivores into Large-Scale Land Management Planning in the Sierra Nevada Mountains of California

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In 1996, a national report to Congress entitled the “Sierra Nevada Ecosystem Project” provided a snapshot of the status of ecosystem conditions in the Sierra Nevada and adjacent Modoc Plateau. Based upon this report, the Pacific Southwest Region of the Forest Service commissioned a science review of the status of these ecosystems and their component species on national forest lands in California. This scientific review became the basis for a large-scale forest planning process known as the Sierra Nevada Framework. The Framework identified key focal species to be considered in designing a new management paradigm to meet the needs of old-forest and other rare species, while dealing with major issues such as fire, fuels build-up and eradication of noxious weeds. This presentation details the management strategies developed for three key forest carnivores: Pacific fisher (*Martes pennanti pacifica*), American marten (*Martes americana*) and Sierra Nevada red fox (*Vulpes vulpes necator*).

5. Multi-Carnivore Conservation Strategy for the American West

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Single-species recovery efforts have helped to make important progress restoring wolves (*Canis lupus*) and grizzly bears (*Ursus arctos*), but this progress has failed to ensure restoration of the broader community of forest carnivores native to the western United States. Conservation concerns are escalating because of the small numbers, reduced range and fragmented distribution of other western carnivores, specifically the lynx (*Lynx canadensis*), wolverine (*Gulo gulo*) and fisher (*Martes pennanti*). Similar to the approach taken to restore wolves and grizzly bears, a multi-carnivore conservation strategy would identify priority areas for the entire forest carnivore community and the conservation measures that are needed in those areas. Detailed information about the distribution and conservation needs of wolves, grizzlies, lynxes, wolverine and fishers was compiled into a carnivore species “richness” map and a single set of conservation guidelines. The map indicates areas of the Rocky Mountains, Northwest and Sierra Range that are still occupied by forest carnivores. The conservation guidelines address threats common to all species, specifically forest practices, motorized access, habitat fragmentation and human-caused mortality. This analysis is a compilation of extensive information that already exists about what is needed and where to begin efforts to restore the whole suite of forest carnivores in the western United States. Because these species serve as indicators of overall ecological integrity, successful implementation of a multi-carnivore conservation strategy would benefit more than the carnivores themselves—it would help to ensure that entire forest ecosystems in the American West remain intact for all dependent wildlife.

6. Conservation Implications of a New Phylogenetic Hypothesis for the Mustelidae Based on Nuclear and Mitochondrial DNA Sequences

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Mustelids comprise the most diverse family within the Carnivora. Mustelids exhibit a tremendous range of ecomorphological diversity, from species that are fossorial (badgers) to those that are semi- or completely aquatic (otters). Higher level relationships within the family have been traditionally based on general morphological similarities, raising the possibility that groupings represent phenetic grades rather than phyletic clades. We examined the phylogenetic relationships within the Mustelidae (19 genera and 38 species) using 4,363 base pairs of DNA sequence data derived from seven nuclear gene segments and the complete mitochondrial cytochrome *b* gene. Maximum parsimony and Bayesian phylogenetic analyses of the total combined data (nuclear plus mitochondrial DNA sequences) resulted in a mostly well-resolved and supported phylogeny. Several striking patterns emerge from our phylogeny: 1) mustelids are divided into five major monophyletic groups that are associated with specific locomotor ecomorphologies; 2) within each of these monophyletic groups, there is a deep split between endemic New World taxa and the other taxa and 3) the American badger (*Taxidea taxus*) is the most basal taxon. The short branch lengths among the major monophyletic groups and the nature of the phylogenetic signal along these branches suggests that mustelids underwent a rapid evolutionary diversification. Our new phylogenetic hypothesis has a number of implications with respect to the conservation of phylogenetic diversity within the Mustelidae.

SWIFT FOXES

Moderator: Axel Moehrenschlager, Calgary Zoo

1. Dispersal and Survival Parameters of Translocated and Resident Swift Foxes in Canada

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Habitat loss, fragmentation and degradation continue to impact imperilled swift fox (*Vulpes velox*) and kit fox (*Vulpes macrotis mutica*) populations from Canada to Mexico. Such pressures threaten many existing populations and may prevent natural dispersal to habitat regions that could sustain these species. Translocations could subsequently be utilized to restore either species to areas of their historic range. Since 1983 a reintroduction program has been underway to restore swift foxes, which were extirpated in the 1930s, to Canada. Over a span of 3.5 years we compared the movement rates, survival and reproductive success of 48 wild-born, resident swift foxes in Alberta and Saskatchewan to those of 29 translocated individuals from Wyoming. High survival rates and successful reproduction indicate that translocation can be an effective reintroduction tool for this species. Radio telemetry showed that survival and reproductive success were highest for foxes with small dispersal distances, suggesting that animals should be acclimated to release sites. Translocated individuals dispersed earlier and over significantly larger distances than concurrently monitored resident foxes, which frequently remained in natal areas until the breeding season. Development within established territories may allow resident juveniles to gradually learn environmental cues such as predator and prey fluctuations, which may result in dispersal times and distances that are less risky and energetically costly than those of translocated foxes. Survival rates were higher for translocated males than females and similar between age classes. Using juveniles for translocation may subsequently minimize impacts on source populations while female-biased releases could lead to equal sex ratios at the release site.

2. Effect of Coyote Removal on Swift Fox Population Ecology

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The swift fox (*Vulpes velox*) was once distributed throughout the short grass prairie of North America. Today, the swift fox exists in the southern and central portion of its historic range. Causes of the decline in the swift fox population include hunting, trapping, poisoning and habitat loss. Recently, predation by coyotes (*Canis latrans*) has been cited as a major cause of mortality of adult and juvenile swift foxes. Predator control has been used in a variety of circumstances to enhance other species populations. However, such control is controversial and has had conflicting results. We examined the extent to which swift fox populations are influenced by coyotes and determined if coyotes are a limiting factor of swift fox populations in southeastern Colorado. From December 1998 to December 2000, 124 coyotes were removed from a portion of the study area, while another area received no coyote control. We monitored 141 (74 male, 67 female) adult and juvenile swift foxes across the study area. Surveys were conducted periodically to assess the abundance of predator and prey species in the community. Changes in swift fox survival, reproduction, dispersal, density, home range organization, social unit structure and activity patterns in the removal and nonremoval areas were analyzed.

3. Genetic Relatedness and Spatial Ecology of the Swift Fox

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We studied the spatial and social ecology of swift fox (*Vulpes velox*) in southeastern Colorado. We used field observations and genetic analyses of relatedness between the foxes to assess space use patterns, the genetic relatedness of foxes relative to spatial distribution, breeding structure, parentage and kinship. We radio-tracked over 180 foxes from January 1997–December 2000 to assess space use by the foxes and their movements relative to those of other members of their own social group and its neighbors. We collected blood, tissue and scat samples and used microsatellite analysis to assess the relatedness of the foxes.

Specific questions to be addressed include whether paired swift foxes are unrelated and whether extra-pair or multiple paternity occurs in swift fox groups. We also examined the patterns of intersocial group relatedness including how neighbors are related and how this affects the overlap of their home ranges. In addition, population level patterns of relatedness were assessed.

4. Behavioral Trait Assessment and Noninvasive Monitoring Methods of Improving Reintroduction of Captive-Bred Swift Fox

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Successful captive breeding and reintroduction programs rely on a variety of factors. Availability of suitable habitat, finance, genetic diversity, prerelease training and physical health are just a few of the components that must be considered.

Several studies have covered the ability to learn necessary survival skills through training and the need for maximum genetic diversity. However, one aspect that is often overlooked is animal boldness, which may be important in survival after release.

This is examined in a release program of the endangered swift fox (*Vulpes velox*). Behavioral responses to four novel stimuli presented twice during a three-month period prior to release were recorded, and individuals were given a boldness score according to their responses. Survivorship of 15 radio-collared individuals were investigated six months following release, to determine whether there was a relationship between behavioral attributes and survival rates.

Five of the 15 released foxes died during the first six months following release. Unpaired t-test analysis showed a significant relationship between boldness scores and survival ($t_{13}=2.802$, $P<0.01$, $P<0.01$), demonstrating that bolder foxes have lower survival rates. Foxes with high boldness scores also showed lower mean later response time ($r_{32}=-0.781$, $P<0.001$) and approached novel stimuli more closely ($r_{32}=-0.779$, $P<0.001$). Noninvasive methods of post-release monitoring are currently being developed to provide more informative means of survival assessment.

5. Population Survey Methods For Swift Fox in New Mexico

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We examined presence/absence and absolute abundance survey methods for monitoring populations of swift fox (*Vulpes velox*) in New Mexico. For presence/absence surveys, the most efficient method is collection of scat followed by verification of species depositing scat with DNA analysis. Using scat, the detection rates of swift foxes at individual locations was 61.9% and 67.7% during surveys in 2000 and 2001. This was greater than the detection rates using scent stations (31.4%, 47.1%) or trapping (11.5%, 8.4%). We detected swift foxes by their scat in 100% of the fox home ranges within the study area. Transects of three scent stations per home range operated for three nights detected swift foxes on as many as 95% of transects, depending on fox density. Searching for tracks, spotlighting and calling are much less efficient methods. For absolute abundance surveys, trapping and resighting with cameras was more accurate than counting unique microsatellite DNA genotypes from collected scats. Using trapping/resighting, we estimated the 95% confidence intervals for the swift fox population within the study area to be 17.8–30.0, 11.9–25.3 and 15.2–17.3 in the periods November 1999–January 2000, February 2000 and January–March 2001, respectively. We counted 63 and 27 unique genotypes in early 2000 and 2001, respectively. The numbers of unique genotypes, which were much greater than population estimates obtained from trapping and resighting, were overestimated because of the presence of transient swift foxes and poor quality DNA from scat leading to allelic dropout and/or false alleles.

6. Introduction to Native American Tribal Fish and Wildlife Operations

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Because of their sovereign nature, Native American tribes offer a unique opportunity for collaboration on wildlife conservation and recovery. One such project is the swift fox (*Vulpes velox*) reintroduction project that has been underway on the Blackfeet Indian Reservation for the last five years. In partnership with Defenders of Wildlife and the Cochrane Ecological Institute, the Blackfeet Nation has been reintroducing the rare swift fox to a parcel of land owned by the tribe along the Rocky Mountain Front. The reintroduction efforts have been quite successful, with excellent survivorship and reproduction each year. Not only are we well on our way toward restoring an important species that had been extirpated in Montana, but many other tribes, individuals and federal agencies are making efforts to reintroduce swift foxes elsewhere throughout the prairies. The swift fox holds particular significance for the Blackfeet and other Plains Indian tribes; being a part of their restoration here on the Blackfeet Indian Reservation is an honor.

WOLF RECOVERY IN THE SOUTHERN ROCKIES

Moderator: Craig Miller, Defenders of Wildlife

1. Wolf Recovery in the Southern Rockies

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Since the mid-1990s there has been considerable interest in restoring wolves (*Canis lupus*) to the Southern Rockies Ecoregion. This area extends from south-central Wyoming, through western Colorado and north-central New Mexico. With much wild land (about 25 million acres) and much wild prey [e.g., an estimated 260,000 elk (*Cervus elaphus*) and 490,000 deer (*Odocoileus hemionus*) inhabit Colorado] this ecoregion could easily support a wolf population. There is considerable public support for restoring wolves to the area (66% of registered voters from the region support restoration), and significant citizen-based efforts have arisen to bring back wolves. Since the ecoregion is nearly equidistant from the population of wolves in the northern Rockies and the population of wolves in southwestern New Mexico and southeastern Arizona, restoring wolves here could provide nature with badly needed grist to recreate a metapopulation of wolves from the Arctic to Mexico. Nowhere else in the world does such an opportunity exist to effect large carnivore restoration over an area of continental proportions. Moreover, the southern portion of the southern Rockies may offer the only hope for recovering the Mexican wolf (*Canis lupus baileyi*).

2. Wolf Recovery in the Southern Rocky Mountains: Evaluating Biological Feasibility

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The southern Rocky Mountain region contains perhaps the largest block of unoccupied wolf habitat in the western United States. We evaluated the potential success of a proposed wolf reintroduction to this region using a spatially-explicit population model that predicted wolf distribution and viability under current conditions and under two contrasting predictions of future landscape change. Our results suggest that the southern Rocky Mountains could support reintroduced wolves under current conditions but that current development trends may result in the loss of one of four potential regional subpopulations and increased isolation of the remaining areas. While much of the wolf population is likely to occur outside core protected areas, these areas remain the key to persistence of viable populations. Our results suggest that social carnivores such as the wolf may be more vulnerable to environmental stochasticity and landscape fragmentation than their vagility and fecundity would suggest. Integrating these types of population viability analysis tools with regional-scale conservation planning may increase the success rates of reintroduction programs for wolves and other area and connectivity-dependent species.

3. Restoring Wolves to the Southern Rockies: The Nexus of Science and Advocacy

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As nongovernmental organizations increase their capacity to participate in and coordinate sophisticated conservation research, the movement to restore wolves to the Southern Rockies may well serve as an advocacy model for endangered species restoration.

Committed to building a peer-reviewed, scientific foundation for their advocacy and litigation strategies, Sinapu and its partners in the Southern Rockies Wolf Restoration Project are blazing a new trail in the murky realm of conservation politics. This approach may help to counter the general deference given by the courts and the public to agency decisions, keeping the debate alive and the decisionmakers engaged.

4. Wolves in Utah: An Analysis of Potential Impacts and Recommendations for Management

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As gray wolves continue to disperse from populations established in Yellowstone National Park and central Idaho, the possibility that wolves will recolonize Utah becomes increasingly evident. Such a recolonization could have significant ecological, economic, political and social effects in the state. We have conducted an analysis of the likely nature and magnitude of these effects, including both general observations and specific predictions regarding habitat suitability, population estimates, ecosystem impacts, impacts on livestock production and ungulate populations, management scenarios and public input processes. We have developed a GIS-based habitat suitability model for gray wolves for the entire state and have used this model to identify regions we designate as core habitat. We then estimated the number of wolves the entire state and each core area could support. We have estimated the likely impact of a relatively large wolf population on livestock production and ungulate populations and how those impacts might translate into economic terms. We have also provided a framework for developing a wolf management plan for the state, which will likely be incorporated as part of a recently initiated effort by the Utah Division of Natural Resources to deal with the issue. This analysis has received media attention because it began as a Utah State University graduate policy course project, and it deals with the controversial topic of gray wolves and possible recolonization in Utah.

URBAN CARNIVORES (I)

Moderator: Seth Riley, National Park Service

1. A Comparative Study of the Urban Ecology of Striped Skunks and Raccoons in a Major Metropolitan Area

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Although raccoons and skunks are common denizens of urban landscapes, many aspects of their urban ecology are poorly understood. I compare the population ecology of striped skunks and raccoons in, and near, the Chicago, Illinois metropolitan area. I live-trapped and monitored raccoons ($n=160$ radio-collared) between 1995–2001 on an urban and rural study area, and skunks ($n=77$ radio-collared) were monitored on the same areas during 1999–2002. The urban raccoon population maintained a higher density than the rural population, whereas there was no clear difference in density estimates between skunk populations. On both areas, raccoons were significantly more numerous than skunks, despite their larger body size. Annual survival estimates remained relatively high (typically >0.75) for raccoons on both study areas, as compared to skunks (0.43–0.45). Skunk survival dropped significantly during winter each year, while raccoon survival rarely exhibited seasonal variation. Cause-specific mortality rates exhibited little change with urbanization for both species, despite considerable differences in traffic volume between the urban and rural sites. Although both species typically lost weight during winter, patterns of weight loss between areas differed between species. Serology results indicate both species appeared to be exposed to a variety of pathogens, especially in urban areas. Raccoon dependence on artificial resources had a dramatic influence on population densities, survival, movement and spacing patterns and winter weight loss. I failed to observe similar patterns in skunks which tended to ignore anthropogenic resources and forage like rural skunks.

2. Coyote Movements, Spatial Organization and Landscape Use in the Chicago Region

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Recently, coyote-human conflicts have increased in the Chicago area, presumably as a result of an increase in coyote numbers. However, relatively little information is known concerning coyote use of heavily urbanized landscapes. During 2000–2001, we monitored the movements of 46 radio-collared coyotes in the northwestern suburbs of Chicago, and we recorded more than 5,000 radio locations. We observed two types of spatial patterns, which were probably related to social status. Those coyotes associated with packs ($n=14$) had small home ranges averaging 9 km^2 , with little or no overlap with other packs. Solitary coyotes ($n=13$) ranged over larger ($P<0.001$) areas and had home ranges averaging 59 km^2 that overlapped extensively with other packs and solitary coyotes. There was considerable individual variation in landscape use, although packs were primarily associated with spaces protected from development and solitary coyotes used nearly every land use type. Mean percent use of forest preserves was $65\pm33\%$ for pack coyotes and only $16\pm17\%$ for solitary coyotes, although this was not significant ($P>0.05$). The pattern was reversed for residential use, which was $28\pm16\%$ for solitary coyotes and only $10\pm14\%$ for pack coyotes, but was not significant ($P>0.05$). Forest preserves and other large open spaces appear to be saturated by territorial packs, thereby forcing solitary coyotes to use a variety of strategies to exploit the urban landscape.

3. Raccoon Home Range and Habitat Use Patterns in an Urban National Park

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We radio-collared and followed raccoons (*Procyon lotor*) in and adjacent to an urban national park in Washington, DC during two main study periods: 1983–1984 and 1989–1990. More than 8,000 locations were recorded for 34 individuals during all seasons of the year. Here we summarize our findings concerning the major aspects of home range and habitat use. We determined home ranges based on both active night locations and daytime resting sites, mapped raccoon home ranges on a seasonal and annual basis and examined the relationship between the use and availability of park and urban areas. We found considerable variation not only between animals in different age and sex classes but between study areas as well. Individual differences in the use of park and nonpark habitats were also obvious, with some raccoons using mostly urban areas and some appearing to concentrate all their activity in parklands. The considerable variation between study areas is interpreted with respect to the type, distribution and density of human residential patterns outside parklands.

4. Life History Comparisons of Sympatric Urban and Rural Foxes in Central Illinois

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Spatial heterogeneity in agriculture-urban landscapes may impact wildlife demography. We studied 334 radio-marked red foxes (*Vulpes vulpes*) from 90 family groups in urban and rural areas of central Illinois to study life history traits. Urban pups and adults weighed more (mean=0.25 kg) than their rural counterparts. Survivorship rates were nearly identical for urban and rural foxes, but yearly variation in survival differed greatly due to periodic sarcoptic mange outbreaks in urban areas, the major source of mortality in all urban age classes. Mange was nearly obsolete in rural areas where coyote predation is the major cause of mortality for juveniles, followed closely by vehicle collisions, the major source of rural adult mortality. Behavior and social organization differed between foxes in urban and rural areas. Spatial separation of rural family members was greater than urban family members during summer, and urban family members were located together more often than their rural counterparts. Juvenile dispersal of rural foxes (mean=10 November) started before that of urban juveniles (mean=14 December) and less than 50% dispersed, while 75% of rural juveniles dispersed. During the winter, rural fox home ranges were nearly four times larger than urban fox home ranges. Our research suggests that urban landscapes may alter fox behavior and social organization due to different mortality sources and greater food and cover resources. In the absence of disease, urban areas may provide refugia from predation pressure from the surrounding rural habitats.

5. Changing Dynamics of a Black Bear Population: Causes and Consequences

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Black bears (*Ursus americanus*) in Nevada occurred historically in the Sierra-Nevada and sporadically through some interior Great Basin ranges. In 1950, the Reno-Carson City area had a population of approximately 50,000 people, a population that has now increased more than six-fold. With urban sprawl advancing along the eastern Sierra-Nevada and in the Lake Tahoe Basin, contact between humans and bears is inevitably increasing. To assess possible effects of increased contact with humans, I tested hypotheses about how bear life history patterns may contribute to population growth in contact zones with humans. The study design involved comparisons between individuals at the urban-wildland interface and individuals in wildland areas. I examined differences in mortality rates, densities, reproductive rates and movement patterns between the two populations. The primary objective was to understand the extent to which resource distribution affected the two study groups. Data on 99 bears will be presented. While preliminary, I suspect that the prolonged drought of the late 1980s was the catalyst that resulted in a population shift to reliance on human garbage. Since 1990, annual citizen complaints of bears have increased by 1000%, and the number of bears hit by vehicles annually has increased by more than 15-fold. As the Sierra-Nevada Range and the Tahoe Basin continue to become more highly fragmented, it may be that bears will no longer exist without contact with urban food sources. I will discuss changes over the last decade in home range sizes, densities, mortality rates and movement patterns of bears in the Sierra-Nevada in relation to urban sprawl.

BLACK-FOOTED FERRETS

Moderator: Minette Johnson, Defenders of Wildlife

1. Black-Footed Ferret Recovery Potential Across the Great Plains

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The black-footed ferret (*Mustela nigripes*) recovery plan calls for ferret restoration to a minimum of ten locations by 2010 as a condition for downlisting the species from endangered to threatened under the Endangered Species Act. These locations must have black-tailed prairie dog (*Cynomys ludovicianus*) complexes large enough to support successful ferret recovery. Based on GIS modeling of potential black-tailed prairie dog habitat and land ownership across the species' historic range, we identify the best locations—politically as well as ecologically—on which to begin or continue prairie dog restoration efforts to facilitate eventual black-footed ferret restoration.

2. The Decline and Recovery of Black-Footed Ferrets—Recovery Program Successes and Continuing Challenges

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The black-footed ferret (*Mustela nigripes*) population was reduced to 18 individual animals by 1987. Recovery of such a critically endangered species is an enormous challenge. This paper focuses on the factors that led to the decline of this highly specialized prairie carnivore and the current status of recovery efforts across North America. We will also provide an update on the revision of the black-footed ferret recovery plan and address existing obstacles to species downlisting and ultimate recovery.

3. Black-Footed Ferret Reintroduction in South Dakota: Challenges and Successes

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Endangered black-footed ferrets (*Mustela nigripes*) prey exclusively upon prairie dogs (*Cynomys spp.*) and use their burrows for shelter. Although ferrets were near extinction by 1987, captive-breeding produced enough ferrets for reintroductions into the wild. The Conata Basin of South Dakota is one of eight sites across six states where ferrets have been reintroduced. Reintroductions of ferrets began in 1996 with the release of 33 captive-born kits, 15 of which were exposed to live prairie dogs and burrows prior to release. Overall survivorship of the 1996 release cohort was 30%. Using an adaptive management approach, preconditioning pens were built on a prairie dog colony in 1997 to expose all ferret release candidates to prairie dogs prior to release. This dramatically increased survival to 67%. During 1996–1999, 167 captive-born kits were released, resulting in a viable, self-sustaining population of 97 adults and 182 kits in 2001. Reproduction in the wild grew from 4 litters in 1997 to 64 litters in 2001, more than all other ferret reintroduction sites combined. The success of ferret reintroduction at Conata Basin is largely due to the absence of sylvatic plague and the presence of large, closely-spaced prairie dog colonies. In 2000, 16 wild-born kits were removed from Conata Basin and released concurrently with captive-born, pre-conditioned ferrets at a new site. Survivorship of the wild-born kits was 81% compared with 45% for the captive-born. Despite the success of Conata Basin, further removal of kits for translocation requires basic research on population dynamics and genetic management to ensure Conata Basin's long-term viability.

4. The Impact of Sylvatic Plague on Recovery of Black-Footed Ferrets

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Sylvatic plague, caused by the bacterium *Yersinia pestis*, was probably introduced into the United States via seaports in the early 1900s. From there it quickly spread into native rodent populations, particularly in western states. The disease was first observed in prairie dogs (*Cynomys ludovicianus*) in the 1930s and has since spread throughout much of the prairie dog range in the United States, causing 90–100% mortality in some populations. Black-footed ferrets (*Mustela nigripes*), an endangered species, rely almost exclusively on prairie dogs for food and on prairie dog burrows for shelter. Ferret management and recovery is tightly linked to prairie dog survival and management. Plague in prairie dogs significantly impacts black-footed ferret survival by destroying their primary prey base. Furthermore, the black-footed ferret is also highly susceptible to plague and may suffer high mortality rates upon infection. The occurrence of plague in prairie dog populations and its potentially devastating effect on black-footed ferret re-establishment is a major impediment to ferret recovery programs. Recently, new vaccines for plague have been shown to increase survival to plague challenge in experimental studies in both prairie dogs and black-footed ferrets and with additional work may prove useful for managing the disease in free-ranging populations.

REWILDING NORTH AMERICA: THE WILDLANDS PROJECT'S MEGALINKAGE APPROACH

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The current mass extinction crisis is the central issue for conservation. Conservationists and biologists have long recognized that protected areas are the most important tool we have. Existing protected areas, however, have not stemmed the tide of extinction. By analyzing the fundamental ecological problems that cause extinction, we can design a better protected areas system. These problems are direct killing, habitat loss, habitat fragmentation, loss of natural ecological processes, invasion by exotic species and diseases and pollution including climate change. To deal with them we must think big in terms of space, time and vision. The Wildlands Project proposes to design and establish a North American Wildlands Network based on four MegaLinkages: Pacific, Spine of the Continent, Appalachian and Boreal. This "rewilding" approach is based on the crucial ecological role played by large carnivores and other keystone species and processes. Examples will be given of specific wildlands networks within the Spine of the Continent MegaLinkage and how The Wildlands Project and cooperators propose to rewild them.

LEAD TOXICITY IN WILDLIFE

Moderator: Kelly Sorenson, Ventana Wilderness Society

1. Lead Poisoning of North American Wildlife from Ammunition and Fishing Tackle

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Despite a 1991 federal ban on the use of lead shot for waterfowl hunting, lead poisoning continues to be a problem for wildlife. Thousands of tons of lead are deposited in the environment through hunting, shooting sports and fishing every year. Water birds, upland game birds, and songbirds may eat lead shotgun pellets and split shot sinkers mistaking them for food or grit. Raptors may ingest lead when preying on contaminated animals such as gunshot-wounded birds. Scavengers are exposed to lead when feeding on contaminated carcasses. Lead exposure can be lethal, and sublethal blood lead levels can compromise health and cause behavioral and neurological dysfunction. Research suggests that lead poisoning is a significant mortality factor in bald eagles (*Haliaetus leucocephalus*), golden eagles (*Aquila chrysaetos*) and California condors (*Gymnogyps californianus*). Because of the continued incidence of lead poisoning, lead ammunition and tackle are being further restricted on some national parks, national wildlife refuges, state lands and in a few states. At the same time, nontoxic alternatives are becoming increasingly available.

2. Lead Poisoning in Bald Eagles in the Upper Midwest

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Lead poisoning continues to affect bald eagles (*Haliaeetus leucocephalus*) throughout North America. Research recently conducted in the Canadian Prairie Provinces as well as continuous monitoring of lead residues in bald eagles in the Midwest indicate that the incidence of birds with elevated lead levels may exceed 50% of the population. The mortality rate is unknown, however experiences at rehabilitation centers suggest it could be substantial. Comparison of the incidence of elevated lead levels seen in a rehabilitation center that treats more than 120 eagles a year for a variety of problems before and after the implementation of steel shot regulations for waterfowl hunting indicates steel shot has had little impact on the overall incidence of lead poisoning. The annual timing of the peak occurrences, along with occasional recoveries of lead from stomachs of affected birds, suggest that shrapnel embedded in deer carcasses may be the likely source of lead. As a further finding, approximately 75% of the poisoning affects mature eagles. The reasons for differential occurrence are not known. Further studies are needed to determine incidence and population impacts.

3. Vulnerability of Condors to Lead Exposure and Intoxication

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Lead ingestion was responsible for three of four known California condors (*Gymnogyps californianus*) deaths in the mid-1980s, and high blood lead levels were associated with morbidity and mortality of at least 10 condors in Arizona and California from 1998–2000. The blood lead levels, clinical symptoms and mortality of California condors have been compared with experimental lead intoxication of Andean condors (*Vultur gryphus*) and other predatory bird species, including bald eagles (*Haliaetus leucocephalus*) and turkey vultures (*Cathartes aura*). Both species of condors appear to be more sensitive than eagles and vultures for two reasons. Condors have not been observed to regurgitate ingested lead or indigestible portions of their food in the form of castings or pellets as do eagles, falcons and owls. As a result, condors appear to retain ingested lead fragments in their digestive system for longer periods than other species, and their blood lead concentrations quickly reach injurious levels. Condors appear to be particularly sensitive to lead intoxication. Clinical symptoms, morbidity and mortality have occurred in experimentally dosed Andean condors at lower levels of ingested lead compared to other species on a mg/kg dose level. Condors do not appear to depurate lead as efficiently as turkey vultures. Capture and treatment of intoxicated California condors has been successful in several cases, with moribund birds recovering from lead exposure after surgical removal of lead shot or fragments and/or chelating of blood lead with Ca EDTA. Lead exposure poses a difficult issue for management of this endangered species.

4. Lead Replacement Technology

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An update on the current status of nontoxic replacements for lead is presented, including some history and some of the chemical/metallurgical limitations. The difference between the requirements for shot pellets and for bullets is outlined. Reason is shown for optimism that the lag between the development of nontoxic shotgun pellets and nontoxic rifle bullets is closing. The new non-toxic rifle bullets will demonstrate exterior ballistic performance equal to their lead-containing predecessors, unlike the long road experienced by shot pellets in achieving that level of performance.

URBAN CARNIVORES (II)

Moderator: John Hadidian, Humane Society of the United States

1. Bobcat Reproduction Relative to Urbanization and Fragmentation in Southern California

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The primary characteristic of bobcat (*Lynx rufus*) habitat in the Santa Monica Mountains National Recreation Area of southern California is its fragmentation. In the current phase of our long-term study of bobcats and urbanization, we are examining reproduction in relationship to habitat patch size and female density. In previous work, we have found that adult female bobcats utilize urban and human-altered habitats significantly less than males do but are still present in natural fragments of habitat. For the last two years we closely monitored radio-collared female bobcats during the putative reproductive period, in both fragmented and contiguous habitat. We found that bobcats will successfully reproduce in small patches of habitat with high human impact and even in developed areas. We determined that multiple females will reproduce in patches of 4.5 km² and may reproduce in patches as small as 0.5 km², although this seems to be dependent on the isolation of the patch. While the birth rate for bobcats does not yet appear to be negatively affected by fragmentation on this scale, the critical parameter for reproductive success in this landscape may be kitten survival.

2. Birds of Prey in Urban Landscapes

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Birds of prey were once thought to be generally intolerant of human presence and activities. In recent years, however, there has been an increased incidence of birds of prey occupying urban landscapes. These patterns of occupancy include wintering by migrants and breeding by a few to a substantial number of pairs. Birds of prey are generally popular with the public and are promoted by state wildlife agencies as “watchable wildlife.” Human experiences with urban birds of prey are usually neutral or positive, but conflicts can arise that are negative for both humans and raptors. Some nesting raptors become aggressive in protecting their nest from perceived threats and excrement accumulation and prey remains near nest sites may be offensive to the public. The urban environment also presents mortality factors that raptors do not experience under normal circumstances. Further, habituation to, and use of, urban landscapes may result in localized ecological and demographic changes for some species. We will explore why some raptors have begun nesting in urban settings, some of the potential problems and conflicts that exist and possible management practice that may resolve some of these problems.

3. Conservation of Endangered San Joaquin Kit Foxes in Urban Environments

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Urban development has resulted in significant habitat loss for the San Joaquin kit fox (*Vulpes macrotis mutica*) which is listed as endangered under the federal Endangered Species Act and as threatened under California state law. However, kit foxes occur in several urban areas in the San Joaquin Valley of California. An investigation of urban kit foxes was initiated in Bakersfield in 1997. The objectives of this study are to 1) characterize the demography and ecology of urban kit foxes; 2) assess the potential contribution of urban kit fox populations to range-wide conservation and recovery and 3) develop conservation strategies for urban kit foxes. Preliminary results indicate that kit foxes are abundant and widespread in Bakersfield with the city-wide population estimated to be 200–400. Urban kit foxes also exhibit high reproductive and survival rates compared to foxes in exurban habitats. Den sites include storm water drainage basins, canal banks, undeveloped fields, golf courses and railroad rights-of-way. Kit foxes consume both natural prey and anthropogenic foods. Urban foxes appear adept at avoiding most hazards including vehicles, dogs, city maintenance activities, and development activities. Relative to exurban habitats, food availability is consistently high in urban environments and natural predators (e.g., coyotes and bobcats) are rare. This may result in relatively stable kit fox populations. Thus, urban kit foxes could contribute to range-wide conservation efforts by serving as “insurance” against catastrophic events in natural lands, increasing genetic diversity and serving as a source population for reintroduction efforts.

4. Coyotes, Fishers and Housecats in a Northeast Suburban Forest Preserve

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The interface between humans and carnivores in suburbia is often contentious. Some species are excluded from these communities by fragmentation and habitat loss, while others adapt to reach high densities. Super-abundant species often cause problems, especially if they associate humans and their dwellings with food (e.g., coyotes attacking pets and livestock) or hunt native prey species to local extinction. To assess the importance of these issues in the northeastern United States, we have been studying a carnivore community around the Albany Pine Bush Preserve (APBP), a fragmented 12 km² suburban natural area. Although declining in western states, fisher (*Martes pennanti*) are increasing in the Northeast, and we found them in a number of forest fragments. Eastern coyotes are abundant in the APBP, focusing their activity around the larger (>200ha) fragments. We estimate two to three coyote packs live in the area, using home ranges less than 5 km². Fecal analyses (n=207) show that coyotes predominately forage for natural foods: 44.6% cottontails (*Sylvilagus audubonii*), 28.4% deer (*Odocoileus virginianus*), 16.2% small mammals and 8.2% plants. Garbage has only been found in 0.4% of the fecal samples and domestic cat only once. Surveys found that only 4.9% of 133 domestic cat owners have had their pets harassed by wildlife and that only 8% restrict their pets' activity to protect them from wildlife. Radio-collared housecats bordering the APBP rarely entered the forest, and only 2 of 31 observed hunts were more than 5 m into the preserve. These results show that generalization across suburban studies may not be reasonable and that relatively "healthy" carnivore communities can survive in close proximity to suburban development.

LYNX BIOLOGY AND CONSERVATION

Moderator: John Squires, Rocky Mountain Research Station

1. Canada Lynx Habitat, Forest Harvest Strategies and Regeneration in Northern Maine

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Habitat relationships can be quantified at different spatial scales. At a multi-state and province scale, Canada lynx (*Lynx canadensis*) in eastern North America are associated with areas with much snowfall and little deciduous forest. At finer spatial scales, little is known about the factors that affect lynx presence within areas of much snowfall and little deciduous forest in eastern North America. To quantify the effects of these factors, we compared landscape attributes in northern Maine where snow track surveys had detected lynx to landscape attributes where lynx tracks had not been detected. Models were constructed *a priori* and compared using logistic regression and Akaike's Information Criterion (AIC). Lynx were positively associated with regenerating forests and negatively associated with forested wetlands, recent clearcuts and partial harvests within 100 km² landscapes. Lynx were more closely associated with young forest than mature forest; over-mature forest was functionally absent from the landscape. A parallel study on snowshoe hare (*Lepus americanus*) habitat selection using the same track surveys and land cover information showed associations similar to those of lynx. Given recent trends in forest management away from harvest strategies that create landscapes with extensive regenerating forest and toward more partial harvest, lynx habitat could be reduced in northern Maine.

2. Effects of Precommercial Thinning on Snowshoe Hare in Maine: Implications for Canada Lynx

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Maine supports a diverse carnivore community and has the only verified population of Canada lynx (*Lynx canadensis*) east of Montana in the contiguous United States. Understanding habitat relationships of snowshoe hare (*Lepus americanus*) is a prerequisite for evaluating effects of human activities on obligate forest carnivores. Recently, intensive forest management, including precommercial thinning (PCT), has been challenged in relation to indirect effects on Canada lynx; however, little research has been conducted on the long-term effects of PCT on snowshoe hare beyond four years post-treatment. We investigated the effects of PCT on snowshoe hare, 1–11 years post-treatment, in six townships in northern Maine. We established 46 km of pellet transects on 17 PCT stands and on 13 unthinned (control) stands. Further, we live-trapped hare on a subset of stands to develop a predictive relationship between densities of pellets and absolute densities of hare at the stand-scale. Snowshoe hare densities were significantly greater on unthinned-control stands than on treated stands during both the leaf-off (October–May) and leaf-on (June–September) seasons. Our results suggest that the effects of PCT in reducing hare densities persist for at least 11 years post-treatment. Although regenerating clearcuts treated with PCT supported lower densities of snowshoe hare relative to unthinned (control) stands, the magnitude of these differences was less than those reported for alternative forest practices. Effects of forestry practices on lynx need to be evaluated at the scale of the landscape to consider alternative forest management practices across the multitude of stands required to support a viable population.

3. Lynx Ecology in Northwestern Montana: An Ongoing Field Study at Seeley Lake

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Since 1998, we have collared over 61 lynx (*Lynx canadensis*) near Seeley Lake, Montana. To date, we have documented 18 mortalities (11 males, 7 females). Primary mortality factors include starvation (38%), predation by cougars (*Puma concolor*) (31%) and trapping/shooting (25%). We have located 13 dens from 7 females and are quantifying den-site selection at multiple-spatial scales. Abundant woody debris was present at all 13 dens, usually in the form of large diameter logs, but smaller logs are used when in “jackstraw” stacks. We study demography to the extent possible given our sample. Preliminary data suggest litters are small and about 50% of kittens survive to independence. We have spent considerable effort documenting habitat selection during winter and summer within forest stands, and we are just beginning initial analysis of these data. As we complete small-scale studies, we will refocus research to address the following issues: habitat use within nonmanaged landscapes, habitat selection of den sites and demography. We are especially interested in understanding lynx movements relative to landscape and habitat features including putative corridors and linkage zones.

4. Diet and Predatory Behavior of Lynx in Sweden

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Aided by legal protection, the Scandinavian lynx (*Lynx lynx*) population has increased to about 2,500 lynxes. This increasing lynx population has led to intensified conflicts with livestock owners, reindeer (*Rangifer tarandus*) herders and hunters who fear predation on livestock and reindeer as well as a general reduction in wild game abundance, especially roe deer (*Capreolus capreolus*). Prey spectrum and predation of lynx was studied based on stomach analyses of lynx throughout Sweden and on data from a field study in south-central Sweden where radio-collared lynx were tracked during 1997–1999. Three hundred lynx stomachs were analyzed, and 19 lynx were radio-tracked for a total of 386 days registering 1,477 radio-tracking positions, 183 km of lynx tracks, 40 hunting sequences and 102 lynx kills. On a nationwide scale, ungulates (reindeer and roe deer) comprised the greatest part of the diet, while a regional division indicated that while lynxes from northern regions had a narrower diet niche, they were in better condition than lynxes from south of the reindeer husbandry districts. Lynx gender and status also influenced diet, predation and condition, while temporal variations in prey density and availability affected seasonal predation rates, as well as between year variations and diet composition. Variable prey species and environmental factors, such as snow and the availability of cover, furthermore affected lynx predatory behavior and hunting success. Securing knowledge on lynx predation and impact on prey populations may aid in balancing conflicting concerns in management strategies for viable lynx populations and desired level of prey densities, in the multi-use semi-natural forest habitats of Scandinavia.

WOLF RECOVERY AND BIOLOGY (II)

Moderator: Mike Phillips, Turner Endangered Species Fund

1. A GIS Analysis and Model of Suitable Habitat for the Red Wolf in North Carolina

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In 1980, the red wolf (*Canis rufus*) was declared extinct in the wild. Since then, wildlife agents have taken cautionary actions towards re-introducing healthy populations from captivity and releasing them in the wild. Researchers are ready to begin the reintroduction process, and they need to locate an ecosystem region containing all of the necessary variables (e.g. habitat, proximity to human population, prey, etc.) to support the reintroduction of the red wolf in the wild. In order to find suitable habitat for the red wolf, a spatial analysis of the area must be completed.

Through Geographic Information Systems (GIS), researchers can examine the different facets of ecosystems in order to find desirable habitats for individual species. Using GIS, this research will examine and identify the necessary variables for the successful reintroduction of the red wolf. An obstacle to this procedure is that little research has been done on the specific details of red wolf habitat; for example, researchers have a difficult time distinguishing between gray wolf (*Canis lupus*) and red wolf habitats. The suitable habitat models used in this research reflect that of the gray wolf. Layers of data such as road density, land cover, deer density and coyote territories are all considered when creating the GIS. The restoration of the species in its native, historical habitat will be furthered as a result of this research.

2. Effects of Habitat Preferences and Competition with Coyotes on Introgression and Extinction in Red Wolves

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One of the greatest biological challenges faced by managers seeking to restore wild populations of red wolves (*Canis rufus*) is preventing hybridization with coyotes (*Canis latrans*). Hybrids between these species produce fertile offspring with no evidence of hybrid breakdown. Consequently, hybridization may result in introgression of coyote genetic material into the red wolf genome and ultimately to extinction of red wolves when no genetically pure individuals remain. I use individually explicit simulations to better understand the factors affecting coyote introgression into the reintroduced population of wild red wolves in North Carolina. Specifically, I contrast the numbers of red wolf pairs and the ancestry of the hybrid population over time and the extinction rate of wolves in simulations with and without habitat selection and competition. In simulations without habitat preferences and in which wolves, coyotes and their hybrids are competitively neutral, introgression proceeds rapidly, and red wolves quickly become extinct unless there is strong management intervention (e.g. sterilization of hybrid and coyote breeders without error). With habitat preferences and differences in competitive ability, the outcome of a range of conditions are explored including hybrid inferiority and superiority of hybrids over inbred red wolves.

3. Winter Wolf Predation in an Elk-Bison System in Yellowstone National Park, Wyoming

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Winter kill rates and prey selection of gray wolves (*Canis lupus*) were studied in the upper Madison drainages of Yellowstone National Park, Wyoming. Elk (*Cervus elaphus*) and bison (*Bison bison*) formed the prey base and a single wolf pack used the study area. Daily ground telemetry, snow tracking, and necropsies were used to acquire data from mid-November to May 1998–1999 and 1999–2000. Of the 108 wolf kills located, wolves preyed primarily on elk and showed strongest selection for calves (n=56). Thirty cow elk (mean age=9.9) and 8 bulls (mean age=5.1) were also killed. One adult and 13 calf bison kills were found. Prey switching was apparent during the first year of study. An analytical method was developed to estimate smoothed kill rates across time using a moving window average and a weighting scheme to account for undetected kills, which indicated 30% of the wolf kills were undetected. Estimated kill rates (kills/100 wolf days) nearly doubled from fall to spring each year, and were nearly twice as high the first year (11.8) as the second year (6.5). Two factors that likely influenced kill rates were confounded between winters. Snow conditions were severe the first year and mild the second, and the wolf pack increased from 7 to 13 wolves between years. Offtake from the calf elk population was the highest among prey types (20–25%). Though offtake was not consequential for adult elk or bison, recruitment of calf elk may be affected by wolf predation, particularly during years of light snowpack.

4. Wolf-Mediated Scavenger Food Webs in Yellowstone National Park

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Gray wolves (*Canis lupus*) sometimes adopt a foraging strategy that results in partial consumption of their prey. We investigate the conditions under which partial consumption occurs and estimate flows of carrion biomass from wolf kills to the scavenger community. Wolves were tracked using radio telemetry until a kill was made. Once located, we sampled feeding activity until the carcass was fully consumed. Species-specific biomass removal was estimated weighting the number of minutes spent feeding by previously measured consumption rates. Factors affecting partial consumption by wolves were wolf pack size, prey size, winter severity and distance to road. Coyotes (*Canis latrans*), grizzly bears (*Ursus arctos*), golden eagles (*Aquila chrysaetos*), bald eagles (*Haliaeetus leucocephalus*), ravens (*Corvus corax*) and magpies (*Pica hudsonia*) were the principal beneficiaries of wolf-provided carrion. Gray wolves may serve as a keystone species by buffering biomass flows to scavenger species that might otherwise experience food bottlenecks.

5. Issues Facing Educators in Light of Federal and State Reclassification of Wolves in Michigan and Wisconsin

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Wisconsin and Michigan are on the docket for federal reclassification of their wolf (*Canis lupus*) populations. Michigan is in the process of state downlisting and Wisconsin's wolf population has been reclassified as state threatened since 1999. Both states have endorsed wolf management plans in place. During this transitional time of downlisting and possible de-listing, educators face challenges pertaining to human attitudes towards wolves. As has been the case in the Upper Midwest, certain targeted user groups strongly vocalize their dismay for the return of the wolf. On the opposite side, many citizens are distrustful of the states' wolf management strategies and would like wolves to stay protected as an endangered species. In some ways, the long-standing debate over wolves on the landscape has become more polarized and the desire of some to take wolf issues into their own hands is more prominent. The need for science-based education is important more than ever. However, at times, educators are caught in the middle of people's demands and what is best for continued wolf viability. Timber Wolf Alliance, a nonprofit education organization based in northern Wisconsin, is working towards solutions that allow all parties to understand the importance of having wolves on the landscape, as well as the need for reasonable wolf management.

6. Teaching About Wolves to Urban and Rural Students

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Rarely do we find neutral opinions toward the wolf. Rural audiences tend to dislike the wolf; urban audiences are typically supportive of wolves. Therefore, different approaches must be taken when addressing these two audiences. When we work with young people, it is important to consider their perspective and develop curriculum accordingly.

It is important to educate both urban and rural students about wolves. It is the urban population that largely affects wolves in the central Rockies of Canada through recreational activities such as golf and skiing. In the rural communities, wolves are affected through conflict with cattle. Therefore, the unique ways in which wolves are affected must be addressed for each community.

In Calgary, Alberta, we have created a program called the Wolves and Wild Places Project to focus on how urban communities affect wolf habitat through their recreational activities. We have also created a unit for rural Alberta called the Wolves and Wilderness Education Project. The focus of this unit is to address the possibility of wolves and ranchers coexisting and still having their basic needs met.

When working with young people, it is not enough to merely present the information. It is critical that a “fun factor” be incorporated into any presentation or teaching unit. Using a dynamic species such as the gray wolf, allows educators to engage young minds and assist them in understanding nature’s complexities. In this way, students will have a positive experience in learning about wolves and other wildlife.

SEALS AND SEA LIONS

Moderator: Jim Harvey, Moss Landing Marine Laboratories

1. Aerial Vocal Development in Captive Harbor Seal Pups, *Phoca vitulina richardsi* and *Phoca vitulina concolor*

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The ability of parents to recognize their own offspring typically coincides with the time that offspring begin to intermingle with conspecific young. In some species, offspring vocalizations may not develop individually distinctive characteristics until this time. Harbor seal (*Phoca vitulina*) pups vocalize frequently, and these calls presumably function to aid the mother and pup in maintaining contact and reuniting once separated. Long-distance pup recognition using acoustic cues is only possible once pups have begun to produce calls with sufficient individually distinctive characteristics to encode signature information. Thus, an analysis of pup vocalizations can determine the earliest pup age at which mothers may begin using acoustic signals as a recognition cue. There has not been any quantitative research on vocal development in harbor seal pups. The goal of this research is to determine when characteristics of harbor seal pup vocalizations become sufficiently distinctive to allow individual recognition using acoustic cues. My hypothesis is that pup vocalizations contain sufficient variability to encode signature information by six days of age, the time at which they would naturally separate from their mothers and intermingle with conspecific young. Preliminary analysis indicates that pup vocalizations are distinctive at an early age.

2. Contaminant-Induced Immune Alterations in the Harbor Seal

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Large-scale die-offs of marine mammals, mainly attributed to disease outbreaks, have apparently increased in frequency and severity during recent years. Associations between such events and polluted coastal waters suggest an important contributing role of contaminant-induced immune suppression. We explored the immunomodulatory role of persistent organic pollutants, including polychlorinated biphenyls and polycyclic aromatic hydrocarbons, in the harbor seal (*Phoca vitulina*), a high-trophic level integrator of environmental contamination in coastal marine foodwebs. To explore effects of pollutant exposure that might result in decreased host resistance to pathogens, we 1) quantified peripheral blood concentrations of pollutants in seals from California and Alaska; 2) characterized, in seal lymphocytes, an important class of signal transduction molecules (protein tyrosine kinases, PTK) fundamental to antigen receptor signaling and cell-cell communication; and 3) exposed seal lymphocytes *in vitro* to model compounds, followed by assays of cellular immune function. Preliminary results demonstrate relatively high levels of PCB, DDE and PBDE in seals along California's central coast, particularly those inhabiting the San Francisco Bay. *In vitro* exposure to model PCB and PAH resulted in depression of mitogen-induced proliferation of T-lymphocytes, a standard measure of cellular immunocompetence. To date, we have identified nine PTK expressed in seal lymphocytes. Analysis of gene expression suggests modulation of several PTK genes following *in vitro* exposure to model compounds. Together, our findings suggest that harbor seals, particularly those in the San Francisco Bay and other populations inhabiting highly polluted coastal marine habitats, may be at risk of contaminant-induced immune alterations and increased disease susceptibility.

3. Pacific Harbor Seal Foraging on Listed Winter-Run Steelhead in the San Lorenzo River, California

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Increasing pinniped populations have caused concern that predation on state and federally listed salmonids by pinnipeds may be contributing to the continuing decline of salmonid populations and hindering the recovery process mandated by the U.S. and California Endangered Species Acts. The San Lorenzo River, located on the central California coast, has the largest run of state and federally listed winter-run steelhead (*Oncorhynchus mykiss*) in the region and has the greatest co-occurrence of harbor seals (*Phoca vitulina*) in and near the river mouth. Harbor seal foraging activity was monitored during daytime hours from December–April in 1998 and 1999, and during daytime and nighttime hours in 2000 and 2001. No active predation was observed during 1998 and only six predation events were observed in 1999. However, during predominantly nighttime observations using night vision goggles, 57 predation events (18 steelhead) were observed in 2000, and 54 predation events (17 steelhead) were observed in 2001. Estimated numbers of steelhead consumed by harbor seals were 111.1 (SD=15.7) in 2000 and 84.4 (SD=11.5) in 2001. Most recent estimates of the winter-run steelhead population on the San Lorenzo ranged from a low of 560 fish to a high of 2,500 fish. Therefore, preliminary estimates of the proportion of the run being consumed by harbor seals, ranged from 4.4%–19.8% in 2000, and 3.4%–15.7% in 2001. Preliminary analyses of harbor seal foraging activity indicated that predation may be a factor limiting the recovery of listed steelhead in the San Lorenzo River.

4. Quality vs. Quantity of Prey: Nutritional Stress and the Decline of Steller Sea Lions in Alaska

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Steller sea lions (*Eumetopias jubatus*) are listed as an endangered species in the western portion of their range, where they have declined by over 80%. Combining what we know about individual energy requirements of sea lions with information about the changes that occurred in the Bering Sea food web suggests that the population decline in Alaska may be related to the inability of young animals to acquire sufficient energy from the low-quality prey available to them (e.g., pollack) compared to the higher energy prey of the past (e.g., herring). There is no indication of a shortage of low-quality prey. However, energetic modeling and captive feeding studies suggest it may not be physically possible for young Steller sea lions to consume enough low-energy prey to meet their daily energetic needs. Consuming fewer calories can stunt growth and cause reproductive failure (e.g., abortions)—symptoms that have been observed in Alaska. A lower nutritional plane may also increase the susceptibility of sea lions to disease and increase their risk of being killed by predators—a factor that may account for the apparent high mortality of juvenile sea lions. Mathematical modeling suggests that killer whales could have been a significant factor in the decline of Steller sea lions, and may now be preventing the population from recovering. Our findings stress the importance of considering the nutritional quality of prey consumed by predators and points to the value of combining fieldwork, captive studies and mathematical models to understand population dynamics.

5. Steller Sea Lions and High-Quality, Ephemeral Prey Species in Southeastern Alaska

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High-quality, ephemeral food resources such as energy-rich forage fish which aggregate during spring, may be particularly important prior to the energetically costly breeding season of sea lions. We developed a spatial database, using a geographical information system which included Steller sea lion (*Eumetopias jubatus*) haul-out locations and spring-spawning eulachon (*Thaleichthys pacificus*) and Pacific herring (*Clupea pallasi*) aggregations. Monthly aerial surveys were conducted to determine the distribution of sea lions and to classify seasonal use of haul-outs. Distances were calculated between sea lion haul-outs and forage fish aggregations. Sea lion haul-outs occupied in spring were closer to forage fish aggregations than haul-outs that were occupied at other times of year. Proximity and access to spring-spawning forage fish aggregations may influence seasonality of haul-out use by Steller sea lions. Ultimately, seasonal pulses of high-energy food resources, such as Pacific herring and eulachon, may be critical to reproductive success of individuals and to maintaining a stable population of Steller sea lions in southeastern Alaska.

6. Benthic vs. Epipelagic Foraging in Diving Mammals: Ecological and Physiological Implications

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Foraging strategies of air-breathing marine vertebrates develop as dynamic relationships between energetic requirements, environmental characteristics and functional performance. Within this context there appear to be two distinct foraging strategies employed by air-breathing marine predators—benthic and epipelagic (midwater) feeding. Functional characteristics define the differences between these approaches. Predators cannot search for benthic prey until the animal has already invested the cost of transport to the deepest point of the dive. By contrast, epipelagic prey move within the water column and the entire dive can contribute to the search effort. Consequently, benthic divers spend more time submerged, a greater proportion of each dive at the deepest component of the dive and more commonly utilize or exceed their available oxygen stores (aerobic dive limit ADL).

The foraging strategy employed by a species may have important conservation and/or management implications. For example, a species that operates at or near its physiological limitations would be less capable of adapting to normal environmental or human made fluctuations in food availability or other changes in its environment. In contrast, an animal that is operating well within its physiological capacity would be more capable of responding to environmental fluctuations. Such animals would be able to draw on a greater physiological reserve to pursue prey deeper, dive longer or forage for greater periods. This presentation will examine differences in the foraging ecology and physiology of two benthic feeding sea lions—the Australian sea lion (*Neophoca cinerea*) and New Zealand sea lion (*Phocarctos hookeri*)—and compare that to the epipelagic feeding California sea lion (*Zalophus californianus*) and Antarctic fur seal (*Arctocephalus gazella*).

KIT FOXES

Moderator: Brian L. Cypher, California State University-Stanislaus

1. Life and Death in the Cotton Fields: Conservation and Recovery of the Endangered San Joaquin Kit Fox

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Although the current range of the endangered San Joaquin kit fox (*Vulpes macrotis mutica*) borders large areas of farmland, the ecology of this species has rarely been studied within an agricultural setting. We monitored habitat use, mortality and diet of radio-collared kit foxes along the right-of-way of the California Aqueduct in central California that was bordered by farmland. Kit foxes concentrated their activities along the right-of-way but they traveled up to 1700 m into some orchards. Foxes used the right-of-way and orchards more than expected based on availability and cotton fields were used disproportionately less. Larger canids were the major source of mortality of kit foxes. Mortality rates of kit foxes were similar to results from other studies. Home ranges were linear and centered over the right-of-way reflecting the importance of this area to kit foxes. Rodent remains were found in 88.4% of the kit fox scat collected in 1999. Small mammal trapping revealed higher densities and a greater diversity of rodents along the right-of-way than on some farmland types. Our results indicate that kit foxes can utilize some types of farmland and that farmland does supply a limited amount of prey to kit foxes. A lack of den sites on farmland appears to be a factor limiting kit fox use.

2. Feeding Habits and Home Range Size of the Kit Fox in the Chihuahuan Desert, Mexico

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The most southern subspecies of kit-fox (*Vulpes macrotis zinseri*) was studied. Few biological and behavioral data exist. Information regarding behavior, space use and feeding habits is also scarce. This subspecies is the least researched. The study was inside the Chihuahuan desert in the Biosphere Reserve Mapimi, Mexico. The objectives in this study were to find more information about their diet and to obtain the home range sizes over a year in this area. The results indicated its diet is mainly composed by 10 food items in order of presence: mammals (64%), medium-size mammals (*Lepus sp.* and *Spermophilus spp.*) (47%), small mammals (*Dipodomys spp.*, *Neotoma sp.*, *Perognathus sp.*, *Peromyscus sp.*) (17%), seed consumption (18%), insects (*Coleopterae*) (4%) and birds 2% during the year. The mean home range size for both sexes was 2.7 km². Females had an area of 2.6 km² and males of 1.38 km². The home range sizes in Durango, Mexico were much smaller than obtained by other authors in northern kit fox studies; for example, Zoellick and Smith in Arizona (1992) determined the size average to be 9 km².

3. The Challenges of Determining Habitat Preference for a Declining Kit Fox Population on Dugway Proving Ground, Utah

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Significant difference in the use of landscape resources by ecologically similar species represents a separation of niche space and a reduced competitive load. Or does it? Many studies' purpose is to find out which habitat components are important to wildlife and the extent to which their use may overlap with potentially competitive species. Unfortunately, such studies are often undertaken when populations are in decline or under interspecific stress. Since an animal's habitat selection is not independent of such conditions, quantifying where they are (use vs. availability methods) may be misleading if species distribution is sub-optimal. An alternative may exist in the comparison of ideal distributions of sympatric species.

This paper compares actual landscape use data of kit foxes (*Vulpes macrotis*) and coyotes (*Canis latrans*) against their ideal distribution as modeled from dietary preferences and prey distribution. Data collected during 1999–2001 included daily radio telemetry relocations of kit fox and coyotes, monthly carnivore scat transects and seasonal prey surveys of small mammals, leporids, lizards and invertebrates. Scat analysis was used to determine the extent of dietary partitioning between the two canids. Relocations, prey surveys and dietary differences were then used to examine coyote and kit fox landscape scale decisions regarding prey choice and territory composition.

4. Characteristics of Refugia Used by Urban San Joaquin Kit Foxes

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A substantial population of endangered San Joaquin kit foxes (*Vulpes macrotis mutica*) inhabits an urban environment in Bakersfield, California. This population could contribute significantly to range-wide kit fox conservation and recovery efforts. Ecological studies on this population indicate that kit foxes frequently use storm water drainage basins for denning, foraging, resting and pup-rearing. Over 200 basins are present in Bakersfield, but not all are used by kit foxes. We initiated an investigation in 2001 to identify the factors determining use of basins by kit foxes. Factors examined included a combination of internal attributes (e.g., size, vegetation structure, inundation and food availability) and external attributes (e.g., perimeter access, proximity to habitat and surrounding land-use patterns). Basins were categorized as "used" or "not used" based on radio telemetry data and evidence of recent use (e.g., dens, scats, tracks). Logistic regression analysis was used to identify the factors that distinguish basins used by foxes from basins not used. Adjacent suitable habitat was the most important factor influencing use of basins by kit foxes. Internal attributes did not appear to be important. The results of this investigation will be used to develop recommendations for urban design strategies that will facilitate the persistence of kit foxes in the urban landscape.

5. Scat-Sniffing Dogs and Fecal DNA Analyses: Comparing Noninvasive Techniques with Radio Telemetry Monitoring

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Recent advances in genetic analysis of DNA extracted from feces, coupled with the use of specially trained dogs to more easily locate scats, offered us the opportunity to compare these noninvasive techniques with radio telemetry monitoring of a population of San Joaquin kit fox (*Vulpes macrotis mutica*) in the LoKern Natural Area near Bakersfield, California. During a 20-day period in winter 2002, three scat dog-handler teams searched 59 km of transects spaced 400 meters to locate 963 fresh kit fox scats. All transects were searched four times, with each search completed within a five-day period. Initial genetic screening with six microsatellites revealed multiple distinct matches of individual scat genotypes to the genotypes of known foxes that had been trapped and radio-collared on the study area. We compare plots of fox locations determined from DNA analysis of scats with fox locations determined by radio telemetry. Even with only a subset of the scats analyzed, our data clearly demonstrate that analyzing DNA from scats can provide information on the locations used by individual foxes that is comparable with that obtained through traditional field methods such as radio telemetry.

6. Kinship and Parentage in Urban San Joaquin Kit Foxes

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Kinship influences behavior in many species of vertebrates. In general, close kin avoid mating with each other but tend to associate and cooperate more than unrelated individuals. We used six highly polymorphic tetrameric microsatellite loci to infer kinship among approximately 240 kit foxes (*Vulpes macrotis*) captured from 1997–2001 during a radio telemetry study in Bakersfield, California. Kit foxes are socially monogamous, and the basic social group consists of a mated pair and any offspring that have not yet dispersed from their natal home range. We used radio telemetry data to identify fox social groups and home range boundaries. We tested three predictions based on an earlier study of kinship in non-urban kit foxes in the Carrizo Plain, California: 1) pair-mates are not closely related; 2) additional adults living with mated pairs are the offspring of at least one of the pair-mates and 3) females living on adjacent home ranges tend to be closely related. We also determined parentage of pups in a sample of litters to see if kit foxes are genetically as well as socially monogamous.

SEA OTTER POPULATION STUDIES

Moderator: James Estes, USGS Santa Cruz Field Station

1. Southern Sea Otter Demography and Population Analyses

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Population projection matrices represent a useful tool for predicting future population trends and for understanding the likely impacts of specific risk factors or management decisions. Available data on southern sea otter (*Enhydra lutris nereis*) demographic rates were compiled in order to construct an age-based projection matrix; however, most data were collected prior to 1990 when the population was increasing (1986–1994 mean $\lambda=1.05$), and were thus unlikely to reflect recent negative population trends (1995–1999 mean $\lambda=0.97$). Two long-term data sets spanning the past 20 years were available: 1) the annual range-wide population counts and 2) the stranding database, including sex and age-at-death (based on cementum analysis of extracted teeth) of all sea otter carcasses collected in California. We employed a Maximum Likelihood Estimation (MLE) technique to simultaneously fit vital rates to both data sets. Logit-type functions were used to generate age-specific rates; additional parameters allowed for effects of sex, location, time (i.e. year) and interactions. We used log-likelihood profiles to calculate confidence limits for each parameter, dropping non-significant terms and then used AIC values to select from among alternative models. The best fit functions indicated decreased adult female survival between 1995 and 1999, with older age-classes particularly affected. We used the MLE functions to parameterize matrices incorporated into a spatial population framework simulating growth within and movement between sub-populations, as well as population expansion into currently unoccupied habitat (i.e. south of Pt. Conception). This simulation model was used to evaluate potential impacts of limiting population expansion to the south.

2. Assessing Population Status Using Activity Budgets: Inter- and Intra-Population Differences in Foraging Effort

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Sea otter (*Enhydra lutris*) density and activity is likely influenced by the quantity and quality of available habitat and prey resources, yet defining relations between resources and population status are tenuous. Time activity budgets of individual animals provide a method to evaluate the status of a population relative to resource, particularly food availability. The underlying assumption of activity budgets in population assessment is that animals in food-limited habitats will allocate more time to feeding behavior than animals in habitats where food is not limited. We have used archival time-depth recorder (TDR) data from sea otters in southeast Alaska, where food and space resources are not limiting population growth, to define sea otter foraging habitat and to estimate the amount of time individuals allocate to foraging activity. We found maximum forage depths to 100 m, 90% of female foraging was to depths less than 20 m and 60% of male foraging was to depths more than 45 m. Females allocated 41% of their time foraging and males 31% (range 27–49%). Contrasts of similar dive depth and activity time budget data from animals currently instrumented with TDRs in California, where population growth is constrained, should provide some measure of the potential role of habitat and food resources in limiting further population growth in California. Contrasts of individuals sampled at different locations within California will provide a measure of spatial variation in activity budgets and the degree to which food resources may be limiting throughout the sea otter's range in CA.

3. Southern Sea Otter Survival: Risks, Rehabilitation and Responsibilities

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Rehabilitation of wildlife is increasingly being used to treat individual animals and to restore wildlife populations after catastrophic events such as oil spills. To evaluate the effectiveness of rehabilitation efforts for the threatened southern sea otter (*Enhydra lutris nereis*), survival and behavior of reintroduced and free-ranging conspecifics were compared. Twenty-one orphaned and rehabilitated and 16 free-ranging juvenile southern sea otters were surgically implanted with radiotransmitters and monitored in the wild for one year to determine survival rates and mortality causes. While a dramatic difference in survival was not found for rehabilitated versus free-ranging juveniles, survival for females was much lower than for males. Free-ranging males also moved further from their weaning site than females, and surviving males stayed with their mothers for longer periods after capture than nonsurviving males. Causes of failure were generally similar for rehabilitated and free-ranging juveniles and included disease and failure to forage. However, rehabilitated animals also failed due to interaction with humans. The survival and dispersal patterns observed for both rehabilitated and free-ranging juvenile sea otters appear to be important characteristics of the population, likely driven by the sea otter's polygynous mating system. Rehabilitation strategies and their potential benefits to the population were further evaluated using cost-benefit decision models based on contingent valuations of sea otters and age-sex survival probabilities. The reproductive potential of individual otters introduced to the population as rehabilitated individuals was assessed using a population model. Both models were useful for quantifying management strategies for the southern sea otter.

4. Analysis of Rehabilitation Data from the Sea Otter Research and Conservation Program at the Monterey Bay Aquarium

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Since the inception of a sea otter (*Enhydra lutris*) rehabilitation program at the Monterey Bay Aquarium in 1984, we have rescued and treated more than 225 sea otters. The challenges of rehabilitating sea otters successfully are not trivial, and the program has remained under constant scrutiny from aquarium management, scientists and the public to demonstrate progress and value. To that end, program managers, caregivers and veterinarians have continually endeavored to evolve techniques and protocols for rearing, rehabilitating and releasing these animals successfully. Data on various criteria used by staff to evaluate the development and "releasability" of each animal are collected routinely; the analysis of this information helps us better understand the specific needs of each case and make refinements to care regimes. Over the past three years, caregivers have made significant strides in pursuing innovative and imaginative sea otter rehabilitation protocols, and the completion and implementation of a relational database system allows us the opportunity to evaluate every activity and technique with a greater degree of assurance than we have ever realized previously. Along with providing general summaries of program data (e.g., numbers of animals rehabilitated and released, caloric requirements for proper growth, the merits of sea otter pups swimming in the open ocean, etc.), this paper will concentrate on several key analyses that affirm the utility and value of specific sea otter rehabilitation strategies and techniques.

5. Causes of Mortality in California Sea Otters Based on Death Assemblage Analysis

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The California sea otter (*Enhydra lutris*) population has gradually recovered from near extinction, punctuated by declines from about 1976–1984 and 1995–1999. Elevated mortality appears to be the main reason for both the sluggish growth and periods of decline. We assessed causes and patterns of mortality from salvage records of 3,105 beach-cast carcasses recovered from 1968–1999, contrasting in particular the periods of population growth with the periods of decline. Overall, an estimated 40–60% of the deaths were not recovered and 70% of the recovered carcasses died from unknown causes. Prime-aged adults (3–10 years) and animals for which cause of death was unknown were more common in the carcass record during periods of population decline. The frequency of carcasses killed by white shark attacks also was significantly greater during the periods of decline. A disproportionately large number of carcasses were recovered during spring and summer, and this pattern was significantly more pronounced during the periods of population decline. Per capita pup production and mass/length ratios of adult carcasses declined significantly over the 31-year study, indicating that environmental conditions for otters are deteriorating. However, neither measure varied consistently between periods of population increase and decline. Neither sex composition nor the proportion of carcasses dying of infectious disease varied significantly between the periods of population increase and decline although the overall high proportion of deaths from infectious disease suggests that this factor has contributed to the chronically sluggish growth rate of the California sea otter population. The population decline from 1976–1984 was likely due to incidental mortality in a set-net fishery.

6. Are Sea Otters Suffering from Inbreeding Depression?

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Sea otters (*Enhydra lutris*) once ranged throughout the coastal regions of the north Pacific until they were extirpated over much of their range due to extensive hunting associated with the fur trade of the 18th and 19th centuries. All contemporary sea otter populations have relatively low genetic variation as a result of historical exploitation. To determine if sea otters now suffer from inbreeding depression, two fitness related variables (one associated with fertility: the male sex hormone, testosterone, and one associated with overall health: the stress related hormone, corticosterone) were measured and compared to relative genetic diversity among populations. Both hormones are known to be affected by inbreeding with decreased testosterone levels and increased corticosterone levels commonly found within inbred lines. There were no significant correlations between testosterone and genetic diversity among sea otter populations, but all sea otter populations had relatively low values comparable to nonbreeding or sterile males within other mustelid species. However, there was a highly significant negative correlation between corticosterone level and genetic variation among sea otter populations. Measuring two variables as reported here does not prove sea otter populations are experiencing inbreeding depression, but the data does suggest a relationship that should be explored. Future genetic and physiological data will be needed to determine significant trends indicative of inbreeding depression that may ultimately affect long-term sea otter population viability.

COYOTES

Moderator: Thomas DeLiberto, USDA Wildlife Services

1. Coyotes, Sheep and Wild Prey: A Model System For Predator-Prey Relationships in Mediterranean Climates

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Little is known about vertebrate predator-prey dynamics in Mediterranean climates, where prey are diverse and their biomass is strongly influenced by variable rainfall. I hypothesized that coyotes (*Canis latrans*) in north-coastal California would respond numerically to overall prey biomass in a manner similar to the responses of some boreal predators to fluctuations in abundance of a single prey. I also investigated the following hypotheses: 1) wild prey abundance relates positively to sheep (*Ovis aries*) predation via its effect on coyote abundance (apparent competition) and 2) wild prey abundance relates inversely to sheep predation via a reduction of the coyote functional response to sheep (positive indirect effects). Because of the close association between abundance of wild coyote prey and annual plant productivity in the study region, I used the latter as a proxy for wild prey biomass. During 1976–1995, coyote population growth rate was positively correlated with plant productivity of the previous year and sheep (ewes + lambs) predation was positively correlated with coyote abundance in the current year. Sheep predation also was negatively correlated with plant productivity of the current year. Strengths of these positive and negative pathways were similar. Coyote abundance and plant productivity explained 47% of the multi-annual variation in sheep kills. Analyses of lamb kills for 176 months revealed similar dynamics and additional insights. These findings indicated the importance of indirect effects between prey via numerical and functional responses of coyotes and demonstrate the general utility of an aggregate prey base concept to understanding trophic dynamics in Mediterranean communities.

2. Home Range and Habitat Use of Coyotes in Michigan

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Coyotes (*Canis latrans*) are one of the most widely distributed predators in North America, successfully inhabiting rural and urban ecosystems alike. Information regarding coyote behavior and territoriality in the eastern United States is fragmentary. In 1966, Ozoga and Harger conducted the only study on coyotes in Michigan, documenting winter activities and food habits in the Upper Peninsula. Our objective was to provide contemporary information on seasonal home range and dispersal patterns of coyotes in the northern lower peninsula of Michigan. Twenty-five radio-collared coyotes (n=15 males and 10 females) were located via radio telemetry four times per week during 24-hour intervals to determine temporal patterns of activity. Radio telemetry data was separated into four biological seasons relative to coyote behavioral changes: reproduction (January 1–March 15), whelping (March 16–April 30), pup rearing (May 1–July 31) and dispersal (August 1–December 31). Additionally, information was gathered on weight, sex, age and body measurements. Average weights of juvenile females, adult females, juvenile males and adult males were 10.9, 12.5, 11.9 and 14.8 kg, respectively. Average territory sizes of juvenile females, adult females, juvenile males and adult males were 20.7, 19.4, 59.6 and 73.8 km², respectively. Ten additional coyotes were equipped with GPS collars, allowing the acquisition of three locations per day for approximately one year. The data collected in this study will be integral toward understanding coyote behavioral ecology in Michigan.

3. Comparison of Reproductive Hormone Patterns in Pregnant and Pseudo-Pregnant Coyotes

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One of the descriptive features of canine reproductive physiology is an obligatory pseudo-pregnancy. Following estrus, non-pregnant females secrete reproductive hormones in patterns similar to their pregnant cohorts. Blood concentration values often overlap between the two groups thus confounding the ability to distinguish a pregnant female from a nonpregnant female.

In this project, seven captive-born female coyotes (*Canis latrans*) were studied for two consecutive years. During one year, the females were paired with males and allowed to breed in 0.1 hectare enclosed outdoor pens. During the alternate year, the females were physically sequestered from their mates although they were housed in adjacent enclosures. Daily blood samples were obtained via venous catheter access and without sedation. Specimens were collected beginning three weeks after the start of behavioral estrus and continued through parturition (approximately six weeks). During the season when the collection females were not bred, specimen collections began during estrus and continued for a total of nine weeks through nonpregnant diestrus. Quantitative serum analysis of estradiol, progesterone and prolactin were subsequently performed. A qualitative plasma assay for the detection of relaxin was validated as a tool in the diagnosis of pregnancy in the coyote.

The reproductive hormone concentrations were compared in two ways: by group, pregnant females and nonpregnant females and by individual, i.e., each female was compared to herself when she was pregnant versus when she was not.

4. Can Diversion Feeding Be Successful in Reducing Coyote Predation of Western Snowy Plover Nests?

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Predation attributed to coyotes (*Canis latrans*) has a significant impact on the nesting success of the western snowy plover (*Charadrius alexandrinus nivosus*) on Vandenberg Air Force Base. Nest losses attributed to coyotes from 1994 through 2001 ranged from 6%–27% of all known-fate nests (19%–80% of all predated nests). Coyotes on Vandenberg Air Force Base have not been exploited since 1978. Coyotes are native predators known to exclude the nonnative red fox (*Vulpes vulpes*) and important in the control of meso-predators such as raccoons and skunks, both significant nest predators at many snowy plover sites. In 1999, we initiated a study of the ecology of coastal coyotes on Vandenberg Air Force Base with the objective of developing a nonlethal management plan that would reduce snowy plover losses to these predators while maintaining ecosystem integrity. Through radio telemetry we have confirmed the high stability of the population of coastal coyotes on Vandenberg and the small sizes of their home ranges, both of which are characteristics expected of an unexploited population. These characteristics make coyotes on Vandenberg prime candidates for new management techniques such as diversion feeding that would reduce foraging on the beaches where snowy plovers nest.

5. Temporal Genetic Variation in a High-Turnover Coyote Population

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In theory, different methods of population control may differ in their impacts on genetic structure. Temporal genetic variation was examined in a coyote (*Canis latrans*) population that experienced intensive removal for several decades. The population experienced separate periods of nonselective and selective control, and comparisons were made between control methods. Analyses at 11 microsatellite loci revealed only subtle genetic structuring between removal regimes. Numbers of alleles per locus (4–16) and expected heterozygosities (0.617–0.915) were high across groups and few first-order relatives were detected within groups. Coyote social structure and dispersal patterns appear to adequately maintain genetic variation and promote genetic homogeneity over relatively small geographic scales during periods of locally aggressive removal.

6. Influence of Extender, Freezing Rate and Thawing Rate on Post-Thaw Motility and Morphology of Coyote Spermatozoa

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Cryopreservation of germ plasma in combination with assisted reproduction is going to play a critical role in sustaining the earth's threatened biodiversity. In addition to supplementing captive propagation, cryopreservation allows for the movement of genetic material rather than living animals across geographically disparate populations. In this study, coyotes (*Canis latrans*) were used as a model for endangered wild canids. This allowed for controlled experimentation, letting us critically evaluate various techniques and methods. The aim of this study was to examine the post-thaw effects of: 1) three cryoprotective extenders (Tris fructose-citric acid, Tris glucose-citric acid, a lactic acid extender), 2) three freezing rates (-1°C per minute, -6°C per minute, -20°C per minute) and 3) three thawing rates (37°C waterbath for 120 seconds, 50°C waterbath for 30 seconds, 70°C waterbath for 8 seconds). The evaluation of viability of sperm cells was based on the percentage of motile sperm cells, progressive motility, morphology and acrosomal integrity. Semen samples (n=150) were collected from 10 male coyotes by electroejaculation, evaluated and extended in one of the dedicated extenders in 0.5 ml straws. Straws from each extender were then assigned to one of the three freezing rates and stored in liquid nitrogen. The straws were randomly assigned to one of the three thawing rates and re-evaluated. Our results indicate that post-thawed viability of coyote spermatozoa are significantly affected by the preservation method selected.

METHODOLOGIES FOR CARNIVORE RESEARCH

Moderator: Robert Long, University of Vermont

1. Counting Tigers With Confidence

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Effective conservation strategies hinge on reliable knowledge of population size. The potential of pugmarks (footprints) as a tool for population estimation of tigers (*Panthera tigris*) was statistically examined by taking morphometric measurements from photographs as well as tracings of pugmarks. Eleven variables were selected out of 96 variables measured and they were found effective in discrimination of individual tigers. Discriminate function analysis (DFA) could distinguish 17 known wild tigers on the basis of their pugmarks with 97% accuracy. The statistical protocol developed in this study was found to be 100% accurate in predicting the correct number of tigers and correct classification of pugmarks, during validation in a simulated 'Census-Exercise' over a blind-set of pugmarks from a known number of tigers.

These variables also discriminated between male and female in a population of 10 known tigers with 100% accuracy. The sex-discrimination model developed by using length and width of the pugmark as a predictor variable was found to be 100% accurate with the 10 known tigers as well as during validation of three new known tigers. The 11 predictor variables were also robust for pooling left and right pugmark. No significant difference was found between pugmarks traced by different tracers ($n=3$) in DFA. Comparison between tracings and photographs suggested that either could be used in the census exercise.

The Expert-System evaluation indicated that accuracy in correct classification of tracings into different individual tigers from a given blind set of 15 pugmark tracings was very high i.e. 92.7% ($sd=7.6$) in case of Indian experts, while it was 79.3% ($sd=10.8$) for foreign experts, 75.7% ($sd=17.5$) for Indian ecologists and 57.9% ($sd=26.2$) for laypersons.

This study suggests that pugmarks can be used as a tool for population estimation of tigers, if subjected to the analytical protocol developed here in within the constraints outlined.

2. Individual Variation in Gray Wolf Squeak Vocalizations

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Two female wolves (*Canis lupus*) studied by Goldman et al. (1995) used squeak (whimper) vocalizations in the den that differed significantly in pitch. The dominant female/mother had a deeper-pitched voice than the subordinate female/non-mother. Pups approached and exited the den only in response to squeaks having the same lower-frequency range as their mother's. These findings suggest that female wolves have individually distinctive voices which pups recognize. An alternative hypothesis, however, is that female voices vary with their social and/or maternal status. This hypothesis follows from Morton's (1977) Motivational-Structure Rules based on which we predict dominant rather than subordinate wolves, and mothers rather than non-mothers, will use lower-pitched calls when interacting with pups. Thus the pups approached the lower pitched squeaks, not because they recognized their mother, but because lower-pitched squeaks reflect social confidence or assertiveness. We tested this hypothesis with individual females using an archived collection of in-den videotapes. Over the nine-year period, the females changed in either maternal or dominance status, so we could determine whether the mean pitch of squeaks varies systematically with such changes. Our specific predictions were: 1) Increases in female rank should be associated with decreases in mean pitch of squeaks and 2) a female's interactions with her own pups should be associated with the use of lower pitched calls. We found, however, that neither change in social status ($n=2$) nor change in maternal status ($n=1$) was associated with any systematic change in vocalization pitch. We conclude that mean pitch of squeaks is likely an enduring individual trait.

3. Long-Range Migration of the Salmon Shark and the White Shark

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The salmon shark (*Lamna ditropis*) and the white shark (*Carcharodon carcharias*) belong to the warm-bodied family Lamnidae. Both species have widespread distribution but their stock structures and individual movements are little known. Salmon sharks were captured and fitted with satellite tags in Prince William Sound, Alaska, and white sharks were tagged without capture in coastal waters of northern California. Salmon sharks aggregate in a number of areas within Prince William Sound and to date one individual has initiated a migration southward along the margin of the North American continent. White sharks aggregate in the coastal waters of northern California but also make long-range movements into oceanic waters west of the United States and Mexico. Salmon sharks utilized waters as cold as 3°C in Prince William Sound, while white sharks occupied waters cooler than 5°C for extended periods during offshore movements. These findings suggest that the salmon sharks and white sharks may possess broad thermal tolerance in comparison to other elasmobranchs.

4. Density of Old-Growth Trees in the Central Sierra Nevada: Do Spotted Owl Nesting Areas Reflect Densities Found in Old-Forest Areas?

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Loss of old-growth forests in the Sierra Nevada has been implicated in the decline of several carnivore species such as the California spotted owl (*Strix occidentalis occidentalis*), the northern goshawk (*Accipiter gentilis*), the Pacific fisher (*Martes pennanti*) and the flammulated owl (*Otus flammeolus*). Land managers must obtain accurate estimates of densities of residual trees and the distribution of these trees throughout the landscape to ensure that habitat for these old-growth dependent wildlife species is adequately protected. However, many large, old trees occur in areas not identified on a course-grained scale (i.e. GIS maps) as “old-growth” forest. The objectives of our study were: 1) to assess how spotted owls select nesting habitat at a fine scale by comparing residual tree densities, canopy layering and canopy closure between California spotted owl nest stands and random stands dominated by medium or mature trees and 2) to estimate the current density of large residual trees in our study area using distance-sampling and compare our estimate with that generated from the Forest Service’s Forest Inventory Analysis data.

5. Scat-Sniffing Dogs as a Tool for Studying Forest Carnivores in Vermont

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Researchers studying free-ranging forest carnivores have typically relied on two methods for obtaining information. The first involves capturing individuals and using radio telemetry to track their movements and survival. The second approach uses techniques (track plates, remote cameras, hair snares, track surveys) to detect a species' occurrence at a given location. While these methods have substantially contributed to our understanding of carnivores, they also have important limitations. Animal capture and telemetry are invasive, potentially harmful to the animal, expensive, time-intensive and typically conducted on relatively few individuals and across small geographic areas. Detection devices often rely on scents or baits to attract individuals, potentially introducing bias if the response is heterogeneous across sexes, age classes or individuals. Further, track surveys are limited by season, weather, and tracking substrate.

Recently, noninvasive fecal (scat) techniques, including extracting DNA and hormones from feces, have provided the means to study aspects of the ecology and physiology of free-ranging wildlife that were previously difficult to quantify. These techniques have generated new interest in scat sampling methodologies. We used professionally trained "scat-sniffing dogs" to systematically locate scat samples from black bears, bobcats and fishers across a variety of landscape and forest types. Information from these samples, including species presence/absence, gender, stress level and reproductive status will allow us to address a number of objectives related to carnivore conservation and research. Here, we discuss our sampling methodology and study objectives and report on the success of this technique based on results from our first field season.

6. Effectiveness of Playback Surveys as a Sole Method To Locate Active Goshawk Nests

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In May and June 2001, a northern goshawk (*Accipiter gentilis*) and red-shouldered hawk (*Buteo lineatus*) playback survey was conducted in the Cayuga Project Area of the Chequamegon-Nicolet National Forest in northern Wisconsin. Alarm and distress calls for both species played at 100db from a speaker. Forest compartments were marked using Geographical Positioning System (GPS) and flagged for easy access and random playback locations were generated using ArcView GIS software. The random location points generated were sufficient to guarantee at least two playback locations per 40 acres. The area surveyed was 5,678 acres. One goshawk nest was located by U.S. Forest Service personnel conducting inventory work and not by the use of playbacks. Four broad-winged hawk (*Buteo platypterus*) nests were located; no red-shouldered hawk nests were found. The sole use of playbacks for location of northern goshawk nests is insufficient for inventory purposes at two playback locations per 40 acres. In addition, some goshawks do not respond to playbacks. Targeted habitat searches by trained personnel coupled with the use of playbacks as a supplemental tool would likely be more effective at locating active goshawk nests.

SEA OTTER THREATS

Moderator: David Jessup, Marine Wildlife Veterinary Care and Research Center

1. A Marine Carnivore, the Southern Sea Otter, as a Sentinel of Pathogen and Chemical Pollution

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As a “keystone” species, sea otters (*Enhydra lutris nereis*) benefit kelp forest-dependent species, but may cause reduced abundance of commercially harvested shellfish. In perhaps less appreciated ways, sea otters can act as sentinels of chemical and pathogen pollution in their environments. This role becomes more important and powerful when it has implications for human health. We have uncovered evidence that a number of bacterial and fungal diseases and protozoal parasites of apparent terrestrial origin, most of which are animal and/or human pathogens, are present in and fatal to southern sea otters. Further, we have found that sea otters may be infected with a number of other diseases that cause gastrointestinal illness in humans and are associated with fecal contamination. Previous work suggests that tributyltin and PCBs may be present in sea otter tissues from more populated areas of California at levels of potential concern. There has been speculation that these contaminants and others that have been found in sea otter prey species may be associated with disease susceptibility. It has also been observed that higher numbers of sea otter carcasses are recovered on years of higher than average rainfall. Mortality is cumulative, and when adult mortality in a slow reproducing species like sea otters exceeds recruitment rate, the population will decline. When some or many of those mortalities are caused directly or indirectly by human activities, only changes in attitudes, actions, management policies, regulations and enforcement are likely to reverse the negative trend.

2. Recent Causes of Mortality in Southern Sea Otters

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Southern sea otters (*Enhydra lutris nereis*) have made a slower than expected recovery since hunting drastically reduced their numbers prior to the 20th century. Annual counts of sea otters over their entire range in California have documented a decline in abundance since 1995. Increased mortality may be contributing to the slow recovery rate in the California population. Detailed post-mortem examination of recently deceased sea otters found along the California coast has provided an exceptional opportunity to understand the factors influencing survival in this threatened marine mammal species. Causes of death for 105 otters necropsied from 1998–2001 were standardized, and the demographic and geographic distribution of causes of mortality were evaluated. The four leading causes of death identified during this period were shark attack, protozoal encephalitis, cardiac disease and intestinal penetration by acanthocephalan parasites. Infectious diseases dominate the pattern of mortality, and the majority of fatal infections occurred in juveniles and prime-age adults. While certain causes of mortality may be under-represented in beachcast carcasses and new causes of death will be identified with advancing diagnostic technology, the epidemiology of disease in juvenile and prime age adult otters is not consistent with a healthy population destined for recovery. The identification of pathogens responsible for substantial morbidity and mortality in sea otters and the geographic distribution of these pathogens is an important first step toward understanding the role of population health in the recovery of this species.

3. Sea Otters in Prince William Sound, Alaska: Status of Recovery 12 Years After the Exxon Valdez Oil Spill

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Sea otters (*Enhydra lutris*) in western Prince William Sound, Alaska, were exposed to large quantities of oil following the 1989 Exxon Valdez spill and mortality was high, particularly in areas with heavy shoreline oiling. Studies to assess sea otter recovery have been ongoing since the spill and considered in conjunction with related studies on lingering oil, prey populations, and other top-level predators provide a picture of long-term ecosystem level effects and identify factors constraining sea otter recovery. In the western sound, overall sea otter numbers have increased and the population is considered to be recovering. However, sea otter abundance in the most heavily oiled areas remains at about half the estimated pre-spill number, with no indication of an increasing trend. Mortality rates of sea otters in oiled areas, including those of animals born after 1989, are relatively high compared to pre-spill rates. Cytochrome P4501A, a biomarker of aromatic hydrocarbon exposure, is elevated in sea otters from the oiled area, and the incidence and severity of gross and histopathological liver lesions is greater in the oiled area, indicating exposure to residual oil through at least 2001. Overall, these results strongly suggest that exposure to lingering oil, either directly or through prey, has continued for over a decade post-spill and is affecting recovery of the sea otter population. This conclusion is supported by related studies that have demonstrated substantial amounts of oil persisting in shoreline sediments and invertebrate bivalves in western Prince William Sound.

4. Chemical Contaminants and Disease in Sea Otters: A Collaborative Approach to Funding and Research

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While levels of contaminants such as DDT, PCBs and butyltins have been measured in marine mammals for years, their overall impact on the health of populations is still unknown. In 1998, the Marine Mammal Commission called for coordinated, interdisciplinary studies to help drive policies on chemical pollution in our oceans. The sea otter (*Enhydra lutris nereis*) was one of five marine mammal species identified by the commission as prospects for multi-disciplinary contaminant research. Research findings over the past decade reveal that 40% of southern sea otter deaths are due to a variety of infectious diseases—an incredibly high rate in comparison to other carnivore populations. Concurrent studies reveal that levels of DDT, PCBs and TBT, a known immunosuppressant, in sea otter tissues are many times greater than levels that can cause reproductive problems in mink (*Mustela vison*), a member of the same family as otters. Other research correlates levels of DDT and TBT with death by disease. In early 2002, 20 sea otter experts and marine mammal biologists, toxicologists, epidemiologists and agency representatives gathered to discuss whether contaminants could be contributing to sea otter disease and other health problems and whether there is enough evidence to warrant a collaborative research effort into the relationship between contaminants and disease in sea otters. This paper will present both the working group's process and their recommendation. This working group concept and the output from the meetings—a solid research and funding scheme—could serve as a model for other wildlife conservation and research efforts.

EFFECTS OF HABITAT FRAGMENTATION ON CARNIVORE POPULATIONS

EFFECTS OF HABITAT FRAGMENTATION ON CARNIVORE POPULATIONS

Moderator: Trisha White, Defenders of Wildlife

1. Responses of Carnivore Communities to Landscape Change in the Adirondacks, New York

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To make better decisions regarding carnivore conservation and management in the Northeast, more information is needed on geographic variation in abundances and changes in community structure in response to human modification of landscapes. The Adirondack region of New York comprises a high diversity of forest types interspersed with anthropogenic habitats and represents an excellent setting in which to examine the relationships between the structure of landscape mosaics and carnivore communities. Using several non-invasive survey techniques—including track plates, camera traps and scat collection—we sampled 55 sites representing a variety of habitat types and land-use regimes over three years (2000–2002) for the presence/absence (and sometimes relative abundance) of mammalian carnivores. Geographic distribution patterns varied across species, with American marten (*Martes americana*) largely confined to higher elevation spruce-fir sites, bears (*Ursus americanus*) found in landscapes with a high deciduous component, raccoons (*Procyon lotor*) associated with nearby water sources, foxes (*Vulpes vulpes* and *Urocyon cinereoargenteus*) absent from the forest interior and fishers (*Martes pennanti*) nearly ubiquitous across the landscape. Coyotes (*Canis latrans*), while present at most sites that we sampled, exhibited a complex relationship with anthropogenic disturbance. Scale was an important determinant of habitat relationships, with some species responding to the same habitat variable differently at different scales; larger scales (5 km) were more important for all species but raccoons. Human factors such as housing and road density, campgrounds and trapping pressure also helped explain variation in carnivore community structure across the landscape. There was some evidence of geographic segregation between carnivore species.

**2. Ecology of a Large Predator in a Small Park:
The Wolf in La Mauricie National Park**

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The conservation of wolves (*Canis lupus*) in small protected areas has been of great concern in recent years. We documented reproduction, survival, dispersal and recruitment inside and outside La Mauricie National Park, Quebec. La Mauricie wolves belong to the subspecies *lycaon* which once occurred in the northeastern United States, the Maritime Provinces and much of southern Ontario and Quebec. We examined the consequences for wolf ecology of a patchwork of areas with different wildlife management and land-use practices. We wanted to test if this small park (544 km²) could be a source of wolves for surrounding areas where wolves are hunted and trapped. We monitored movements and behavior of wolves using radio telemetry. Fieldwork began in April 2000, and we have radio-collared 15 wolves, of which only 6 survived the trapping season. Of 3 wolves caught in the park, 2 dispersed and died within a few weeks. The park area was equivalent to the home range of a single pack. Although large protected areas may play a key role in the conservation of large carnivores, it appears that a small protected area like La Mauricie National Park is insufficient to have any impact on wolf populations.

EFFECTS OF HABITAT FRAGMENTATION ON CARNIVORE POPULATIONS

3. Landscape-Level Correlates of Fragmentation on Home Range Overlap of Eastern Coyotes

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The social organization of coyotes (*Canis latrans*) present in human-dominated landscapes is poorly understood. Further, no data exist regarding the linkage between the dispersion of critical resources and the spatial distribution of coyotes. We investigated landscape-level correlates of fragmentation on coyote territoriality and social organization to determine whether habitat fragmentation may, in some instances, facilitate overlap and interaction. Overlap in home ranges of family groups averaged 82.7%, and degree of spatial interaction was high (r_s ranged from 0.81–0.99). Overlap of spatial groups averaged 21.8%, and degree of spatial interaction was more variable (r_s ranged from -0.77–0.95). The intensity and duration of simultaneous interactions among family groups (HAI score=0.53) was substantially greater than that of spatial groups (HAI score=0.02). Only two of five spatial groups (1 male-male, 1 female-male) displayed simultaneous attraction to the overlap zone. All groups displayed similar resource selection within the overlap zone, selecting forest and grass habitats while avoiding urban and agricultural patches. Area of forested habitat within the overlap zone and mean squared difference of nearest neighbor distances between forested patches within the group territories explained substantial amounts of variation in home range overlap ($R^2=0.76$, $P<0.001$). We contend that the complex combination of environmental pressures present in human-dominated landscapes may facilitate spatio-temporal home range overlap in coyotes.

EFFECTS OF HABITAT FRAGMENTATION ON CARNIVORE POPULATIONS

4. The Influence of Linear Features on Wolf Movements in the Central Rocky Mountains, Canada

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Human-caused modifications of the landscape, such as roads, railway lines and trails, may change the spatial structure of the environment to which wildlife must respond. Such modifications of the landscape can affect wildlife movements, population distribution, survival and predator-prey relationships. Natural linear features, such as rivers, may also influence wildlife movement patterns.

I used snow-tracking data collected from four wolf (*Canis lupus*) packs in the Central Rocky Mountains over six winters and General Linear Models to test the hypotheses that wolves respond to linear features differentially, and that traffic volume affects road crossing frequencies by wolves. I used 13 years of wolf mortality data to test the hypothesis that traffic volume affects level of automobile-caused wolf mortality. I also assessed the permeability of the Trans-Canada Highway and wildlife underpasses to wolf movements.

High traffic volume reduced the proportion of successful crossings. Wolves were attracted to compacted trails and roads with low traffic volume. Wolf deaths per kilometer were greater for roads with high traffic volume. The response of wolves to underpasses appeared varied among wolf packs.

Human activities that modify snow compaction influence winter movements of wolves by providing travel routes that are energetically less demanding than unmodified routes. Wildlife managers should incorporate the potential effects of linear features on wolf survival, movements and wolf-prey relationships in the planning process.

SOUTH AMERICAN CARNIVORES

Moderator: Gerald Zuercher, Kansas Cooperative Fish and Wildlife Unit

1. Comparative Analysis and Ecological Implications of the Biomass Eaten by Four Species of Small Neotropical Cats in the Wild and in Captivity

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A comparative analysis of the biomass eaten in the wild and in captivity by little spotted cat (*Leopardus tigrinus*), margay (*Leopardus wiedii*), jaguarundi (*Herpailurus yagouaroundi*), and Pampas cat (*Leopardus colocolo*) was performed to assess the macroscopic aspects of prey utilization in the wild and the quantitative aspect of food provided by zoos. The average biomass consumed in the wild and in captivity diverged considerably for all species, except jaguarundi. Distribution of prey mass differed, with little spotted cat preying on the smallest class sizes, margay mainly on medium-sized (arboreal) small prey, jaguarundi on prey more than 75 g, and Pampas cat on the smallest and largest prey-class sizes. Food-niche organization showed areas of overlap in segments. A variety of vertebrate prey were taken, mostly small mammals. Reptiles and birds were also important, especially in the little spotted cat and jaguarundi diet. Circadian activity of prey suggested diurnal activity for little spotted cat, nocturnal for margay and Pampas cat and at all hours for jaguarundi. Strong positive correlations were observed between biomass eaten in the wild and felid body mass, canine diameter and prey mass, and felid body mass and maximum prey taken, but not between maximum prey mass and canine diameter.

2. Effects of Human Activities on Carnivores of the Cerrado Ecosystem of Brazil

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The Cerrado Ecosystem is a high biodiversity open forest and grassland system threatened by land conversion for ranching and agriculture. The study was conducted in and around Serra da Canastra National Park in southeastern Brazil which supports 38 medium to large terrestrial mammal species, including 15 carnivores. The study assessed the impact of three types of human disturbance (ranching/farming, traffic and tourist activities) in the surrounding areas and within the park by comparing indirect signs along transects in disturbed and control areas. Data on presence or absence of species was used to indicate how taxonomic diversity was affected by the different impacts. Carnivore species differed significantly in response to the impacting activities. The highest difference in species diversity was seen between the ranching/farming-impacted areas and protected habitats. Areas impacted by local traffic and tourism showed lower diversity when compared to the control habitats, but not to the same degree as ranching/farming areas. In extremely disturbed habitats, even the most adapted species are absent. Gallery forest habitats (deciduous and semi-deciduous mesophytic forest formations) were found to be refuge areas for most mammal species, even those fragmented by ranching/farming activities. In summary, some species are responding positively to human development, persisting in disturbed habitats and keeping their populations stable over the years. On the other hand, there are still several species sensitive to human presence, which may eventually be subject to extirpation.

3. Local Perceptions of Jaguars and Pumas in the Iguaçu National Park Area, South Brazil

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Retaliation for livestock losses is one reason local residents kill jaguars (*Panthera onca*) within the boundaries and lands surrounding Iguaçu National Park (INP), Brazil. Both pumas (*Puma concolor*) and jaguars occur in the Iguaçu forest, however, livestock depredation by pumas has rarely been reported. Due to depredation on domestic animals and the subsequent killing of jaguars by rural residents, we hypothesized that the local people hold negative perceptions towards natural predators, especially jaguars. The objective of this study was to assess the local perceptions in and around INP toward jaguars and pumas. Our results revealed that rural residents with negative perceptions toward jaguars (26.4%) did not represent the majority of the rural population residing within the boundaries of INP. Interestingly, most people (68.5%) erroneously believed jaguars had been brought from other regions and released into INP. We suggest the jaguar killings, which may have a considerable effect on the local jaguar population, are the responsibility of a minority of rural residents. This is apparently the first study on local perceptions towards large carnivores in Brazil.

4. Jaguar Predation on Livestock: A Reported Case of a “Problem Animal”

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Jaguar (*Panthera onca*) depredation on livestock was recorded at 42 ranches surrounding a protected forest in southern Brazil from January 1998–April 1999. We recorded livestock holdings, livestock losses due to depredation by jaguars and pumas (*Puma concolor*) and the monetary value of those losses. In 22 of the 42 properties, landowners reported livestock losses due to depredation by jaguars from 1995–1997. We personally recorded losses due to depredation on 11 of those 42 properties. We recorded 38 attacks (37 from jaguars and 1 from a puma). Twenty-nine domestic animals were killed and nine were wounded. Livestock losses included 17 head of cattle (58.6% of losses), 2 horses (6.8%), 5 sheep (17.2%) and 5 dogs (17.2%). One female jaguar wandering with a cub was likely responsible for most of the attacks. From April–October 1998, female #71 killed 19 animals and wounded 7 more. On March 9, 1999, #71 was captured. Eight shotgun pellets were found in her chest and right front leg. No more attacks by this female were recorded following treatment and release into the reserve. We suggest that the pattern of depredation by this female and her cub might have been related to poor livestock management in the region, to the presence of the cub and to the limitation in hunting wild prey caused by her human-inflicted wounds.

5. Dietary Separation and Overlap Between Mammalian Carnivores in Eastern Paraguay: Evidence from the Dry Season

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A diverse mammalian carnivore community exists within the Reserva Natural del Bosque Mbaracayú (RNBM) in eastern Paraguay. This community includes several threatened or endangered species as well as increasingly present domestic dogs and cats. The diets of 16 wild carnivores were determined from feces and the remains of kills. Feces were collected from the reserve during the dry seasons (June–September) of 1999, 2000 and 2001. Bush dogs (*Speothos venaticus*) had only moderate dietary overlap with other species and appeared to occupy a unique role within the carnivore community. Remains of four other mammalian carnivore species were detected in the feces of jaguars (*Panthera onca*) providing evidence that the role of jaguars as the top carnivore in this system is maintained by interference competition, which includes depredation on other carnivores. Diet breadth calculations indicate maned wolves (*Chrysocyon brachyurus*) and crab-eating raccoons (*Procyon cancrivorus*) had the most general diets while small felids, crab-eating foxes (*Cerdocyon thous*) and long-tailed otters (*Lontra longicaudus*) have the most specialized diets. Comparison of dietary overlap among all carnivore species showed strong similarities in diets of small felids and some mustelids. A model of potential interspecific interactions was developed reflecting carnivore diet niches along a preference axis ranging from 100% plant to 100% animal dietary content.

RECOVERY OF RARE CARNIVORES

Moderator: Nina Fasscione, Defenders of Wildlife

1. Jaguar Ecology in Sonora, Mexico: Tools for its Recovery and Protection in Arizona

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As recently as the mid 20th century, a population of jaguars (*Panthera onca*) lived in the southwestern United States. Currently, the northernmost breeding population of jaguars lives 135 miles south of the international border in the Mexican State of Sonora. The principal habitat there consists of a mosaic of oak woodlands and thornscrub, and cattle ranching is the primary land use. Our purpose was to understand jaguar ecology in Mexico and the importance of recovering the species in Arizona. From July 1999–December 2001, we used camera traps, track and prey surveys. We estimated jaguar densities at 1.4 ± 0.4 ind/100 km². We observed that jaguars use oak woodlands more than expected, are considered nocturnal and are preying on white-tailed deer and livestock. Jaguars had a capture success of 0.36%, compared with 1.76% for mountain lions. Jaguar poaching was comparable to the estimated densities (1 jaguar/100 km²). Turnover rate in this population can reach its maximum exploitation, if no measures of limited harvest are met. Efforts to maintain the resilience of this population should concentrate on restricting poaching and improving ecological understanding of the species.

2. Building Tolerance for Bear and Wolf Recovery

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Grizzly bears (*Ursus arctos*) and wolves (*Canis lupus*) are slowly reclaiming parts of their former ranges in the lower 48 states. Occasionally, these carnivores prey on livestock or come into conflict with humans. Defenders of Wildlife has created two programs to build tolerance for wolf and grizzly bear expansion in the Northern Rockies and thus prevent them from being killed, both legally and illegally.

Since 1987 Defenders has paid compensation for livestock losses caused by wolves and in 1997 assumed responsibility for grizzly compensation and expanded the geographic scope of the compensation program. Since that time we have paid out close to \$70,000 for livestock that has been verified killed by grizzly bears and over \$200,000 for wolf-caused losses. By assuming the economic responsibility for bear and wolf damage, we have built greater tolerance among livestock owners for the recovery of these species and reduced the likelihood of landowners resorting to the "shoot, shovel and shut up" approach.

More recently, Defenders created the Bailey Wildlife Foundation Proactive Carnivore Conservation Fund to prevent conflict between imperiled predators and humans before it occurs. It is a natural outgrowth of our wolf and grizzly compensation programs. This proactive fund has three objectives: 1) to reduce conflicts between predators and humans; 2) to keep predators from being unnecessarily killed by agencies in response to human conflicts; and 3) to increase general tolerance for carnivores across the landscape. To date, we have worked cooperatively with landowners on a number of successful projects, including installing electric fencing around bee yards, creating secure calving areas or sheep bedding grounds, purchasing livestock guard dogs, paying for aversive conditioning by Karelian bear dogs and bear-proofing campgrounds and dumps.

3. Mexican Wolves: Status Report and Challenges Facing the Captive-Breeding Program

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Among the formidable challenges facing the Mexican Wolf Recovery Program is the release of captive-raised wolves. This presentation will outline the current status of the Mexican Gray Wolf in captivity and the challenges facing captive managers in raising a "wild wolf."

Listed in 1976 as an endangered subspecies under the Endangered Species Act of 1973, the Mexican gray wolf is one of the rarest land mammals in the world. The captive breeding program began in the early 1980s after five wolves were removed from the wild. The ultimate goal of the Mexican Wolf Recovery Plan, signed by federal wildlife agencies in the United States and Mexico in 1982, is the re-establishment of wild populations from captive-raised wolves. The captive population was managed by the U.S. Fish and Wildlife Service, Mexican Wolf Recovery Team until 1985 when a consortium of holders of Mexican gray wolves called the "Mexican Wolf Captive Management Committee" was established. Since 1993, the population in the United States has been managed by the American Zoo and Aquarium Association Species Survival Plan. Through the efforts of the captive breeding program, today about 240 Mexican wolves survive, most held at 43 captive facilities in the United States and Mexico. The balance are free-ranging in the Apache and Gila Forests along the Arizona-New Mexico border.

SEA OTTER BEHAVIOR AND PHYSIOLOGY

Moderator: Andrew Johnson, Monterey Bay Aquarium

1. Foraging Ecology: Sources of Variation in Dive Behavior, Diet and Foraging Success

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The reproductive success of carnivores can be influenced by what they eat, thus diet and foraging behavior can directly impact individual fitness. This is especially true when prey resources limit population size. In such cases, selection should be strong on individuals to adopt foraging tactics that maximize fitness, and we might therefore expect convergence on “optimal” behavior. We studied diet and foraging behavior of southern sea otters at three locations within their range: Monterey Peninsula, where population density is high (7.3 otters/km² seafloor to 40m isobath) and where there has been no net growth since 1985 (P=0.57, mean λ =1.00); San Simeon, where density is lower (2.6 otters/km²) and has increased slightly since 1985 (P=0.001, mean λ =1.01); and Pt. Conception, where re-colonization began only five years ago and density is very low, seasonally variable and generally increasing. At each location we studied the foraging behavior of 15–20 sea otters instrumented with Time-Depth Recorders (TDRs). Dive data recorded with TDRs included time at depth and subsequent time at surface, dive depth and bottom time. We visually determined success (yes/no), the number/size/type of prey items captured and prey handling time. By contrasting the three study areas, comparing data with similar data collected in the 1980s, we characterize spatial, temporal and individual variation in diet composition and foraging behavior. Differences between individuals represented the greatest source of variation. We propose mechanisms that might give rise to alternative foraging specializations and discuss the implications of individual-level variation for population and community-level processes.

2. Application of Individual-Based Movement Models to Movement Patterns of California Sea Otters

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Quantitative models describing individual movement behavior are valuable tools for predicting large-scale spatial distribution patterns and metapopulation dynamics. Individual movement models (IMM) have been developed for invertebrates and some small vertebrates, but there is a paucity of such models for large carnivores. The southern sea otter (*Enhydra lutris nereis*) is a tractable subject for developing IMM because all movements occur within a narrow, near-shore region and are thus easy to measure by radio telemetry. We analyzed daily movement data recorded from radio-tagged sea otters from November 1985, November 1987 and from March 2001–present. Individual paths of sea otters were quantified using measures of mean move length and probability of turning to or from the home range center (home range boundaries and centers were defined using standard harmonic mean analyses). Contrasts of age and sex classes showed significant differences in move lengths ($n=2859$, $F=31.19$, $P=0.0059$, $\omega^2=12.75$) and turning probabilities ($n=2859$, $F=39.7$, $P=0.00061$, $\omega^2=16.24$) for juvenile males. We used a general linear model to describe relationships between environmental heterogeneity and individual movements. Finally, we generated age- and sex-specific probability density functions for monthly individual movement distances (assuming long-distance moves can be described as a Poisson process) for use in a spatially explicit population simulation model [see Tinker and Doak, Southern Sea Otter Demography and Population Analyses]. Future analyses will test the application of random walk models to predicting fine scale foraging movements in sea otters in California and the Aleutian Archipelago.

3. Nocturnal Foraging Ecology of the Sea Otter in Elkhorn Slough, California

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Sea otter (*Enhydra lutris*) foraging behavior has been well studied in a variety of habitats, but all direct observations necessarily have been during the daytime. Radio telemetry has been used to quantify nocturnal behavior of sea otters, but some foraging parameters cannot be quantified through dive duration alone. Recent technological advances and the commercial availability of Generation III night vision equipment has made direct observations of nocturnal behavior possible for the first time. The feasibility of using night vision goggles was established in this study. I quantified the nocturnal foraging behavior of sea otters in Elkhorn Slough, California, through focal animal sampling. I compare dive duration, prey species composition and foraging success rates of sea otters feeding nocturnally with daytime data previously collected by Jolly (1997). Using scan sampling, activity budgets were also calculated for nocturnal sea otter behavior and compared to published activity budgets, both diurnal (obtained via visual observations) and nocturnal (obtained via radio telemetry), for animals in California and elsewhere. I discuss the effectiveness of the different sampling methodologies in the study of nocturnal foraging behavior. Nocturnal foraging of sea otters provides information about the relative importance of vision to foraging sea otters and allows for unbiased calculations of energy consumption and activity budgets for the entire 24-hour period.

4. Thermoregulation and Diving Energetics of the California Sea Otter: Are They Pushing Their Physiological Limitations?

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For many carnivores, the ability to find, capture and consume prey can be limited by prey abundance and the physiology of the animal. Because of their small body size (compared to other marine carnivores), fur insulation and high nutritional demands, sea otters (*Enhydra lutris*) may experience unique physiological constraints. In areas where prey availability is variable or scarce, because of habitat degradation or density-dependent impacts of otters on their prey populations, individuals may be pushed beyond their physiological limits. In such cases, certain age/sex classes may experience decreased survival. To investigate the extent to which sea otters may be limited by energetic or thermoregulatory demands, we radio-tagged 45 sea otters along the California coast. We studied core body temperature, ambient air and water temperature, activity budgets, dive behavior (dive depth and bottom time) and prey consumption rates. In a recent study, we examined the oxygen consumption and core body temperature of two captive male California sea otters during voluntary dives of 1.5 m, 3 m and 9 m with short and extended bottom times. By quantifying the energetic and thermal costs of diving, we were able to estimate the rate of energy acquisition (prey capture success) required for animals to maintain a positive energy balance and then compare this estimate with the data collected from the wild population. Such information will be critical to understanding the factors limiting recovery of sea otters in California.

LANDSCAPE LINKAGES

Moderator: Bill Ruediger, U.S. Forest Service

1. Wildlife Linkage Areas: An Integrated Approach for Canada Lynx

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Conservation planning for forest carnivores now appropriately includes management considerations for habitat connectivity at a landscape scale level. We provided guidance for lynx linkage area mapping in the Canada Lynx Conservation Assessment and Strategy, second edition, August 2000. At this time, we are drafting maps of potential linkage (connectivity) areas by conducting interagency meetings in the western states within the historic Canada lynx (*Lynx canadensis*) range. Participants in these meetings include representatives from state wildlife agencies and state departments of transportation, federal agencies including Federal Highway Administration, Bureau of Land Management, National Park Service, USDA Forest Service, tribal governments, private conservation groups and others. We view this as an ongoing process that involves incorporation of information gathered at the meetings and subsequent production of draft maps that are sent back to participants for review. We are one year into an estimated two-year process to draft these linkage areas for Canada lynx.

2. Ecosystem Scale Linkage Identification and Implementation for Grizzly Bears and Other Rocky Mountain Carnivores

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The fragmentation of carnivore habitat in the Rocky Mountains on both sides of the U.S.-Canada border is an ongoing threat to the survival and recovery of these populations. Human development is the cause of this fragmentation. Major development causing fragmentation includes private land conversion into home sites and highway construction and improvement. If carnivores such as grizzly bears (*Ursus arctos horribilis*), wolves, (*Canis lupus*), wolverines (*Gulo gulo*), lynx (*Lynx canadensis*) and fishers (*Martes pennanti*) are to survive and recover to healthy population levels in the Rocky Mountains, the issue of fragmentation must be addressed by identifying linkage zones between habitats and managing them in a way that promotes use of these zones by carnivores. This will entail landowner outreach and proactive management on privately owned linkage areas and development of effective highway crossings for wildlife.

We have been involved in the development of a linkage zone identification effort as part of the grizzly bear recovery program. As part of this effort, we have developed a linkage zone prediction model that was used to identify the linkage areas within and between the major blocks of public lands in the Rocky Mountains of Montana and Idaho. We have initiated an interagency management effort to assure that the movement opportunities within the existing linkage areas are maintained. This management effort involves the creation of task forces for public lands, private lands and highways. The function and plan of action of these task forces to implement linkage zone management is detailed.

3. A Regional Assessment of Landscape Permeability For Large Carnivores in the Pacific Northwest

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Understanding the distribution of blocks of habitat and the potential for movement between those blocks is important for the development of informed management and recovery plans for sensitive large carnivores. We conducted a regional scale assessment of landscape permeability for lynx (*Lynx canadensis*), wolverine (*Gulo gulo*) and a general forest-associated large carnivore model in Washington, Oregon and Idaho. Using weighted-distance and least-cost GIS techniques, we evaluated the distribution of roads, human population density, land cover type and topography to evaluate the relative potential for large carnivore movement.

4. High, Wide and Handsome: Designing More Effective Carnivore Crossings for Roads and Highways

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Carnivores are often required to cross major highways to move within their large home range sizes and to disperse. As wildlife and fish crossings along highways and roads become more common, the emphasis will change from defending their legitimacy to increasing their effectiveness. In the recent past, when wildlife and fisheries crossings were provided, it was often on the basis of "least cost." Unfortunately, many of these structures did not meet the intended purposes—or did so marginally. Carnivores also may be more wary than other species such as deer and elk, and hence some highway crossings were less effective for these species than others. Road and highway wildlife and fisheries crossings should be planned and designed for multiple species. By applying ecological and behavioral concepts the effectiveness of wildlife and fisheries crossing structures can be greatly improved. More effective structures will also be more expensive. Factors such as the height, width, approach, bottom surface, lighting and spacing need careful consideration. Future structures should appear more natural to increase use and should be placed where animals would naturally use them. Culverts in stream channels present potential problems to fish and wildlife passage. Their effectiveness in situations where wildlife and fish passage is important is limited, and other types of structures should be considered.

CARNIVORE DISEASES

Moderator: Krista Hanni, The Wildlife Health Center

1. Disease Ecology of Wild and Domestic Carnivores in the Bolivian Chaco

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Infectious disease is increasingly being recognized as a threat to free-ranging wildlife. Some species have experienced population declines due to disease outbreaks, and domestic animals have often been implicated as the source. Ample evidence exists that in both captivity and the wild, nondomestic carnivores are susceptible to domestic dog and cat diseases. However, little is known about the effects (or even the presence) of diseases on carnivore populations in South America. The Kaa-Iya del Gran Chaco National Park in Bolivia is located approximately 40 km from an inhabited area. The Izoceño-Guaraní people use the land between their settlements and the park for subsistence hunting, an activity that includes dogs. We hypothesize that wild carnivores living adjacent to human settlements are more likely to be exposed to domestic carnivore diseases than are wild carnivores living in more remote regions. To test this hypothesis, we are sampling domestic dogs and cats and wild carnivores, interviewing villagers about dog demographics and estimating contact rates between domestic and wild carnivores. In addition, information on seroprevalence of diseases in domestic carnivores, coupled with estimates of contact rates between domestic and wild carnivores, is being used to construct an epidemiologic model to predict the likelihood of disease transmission to the wildlife species. Our results thus far are preliminary, but we have found that domestic dogs in the villages have a very high neonatal mortality rate, and based on serologic tests, many infectious diseases are maintained in the domestic carnivore populations.

2. The Role of Infectious Disease in the Decline of Island Fox Populations in the Channel Islands, California

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The island fox (*Urocyon littoralis*) is found only on six Channel Islands off the coast of California. Island fox populations on four of the six islands have declined by as much as 95% since 1994, resulting in critically low population sizes, federal listing as a candidate for endangered species status and IUCN listing as critically endangered. To safeguard remaining foxes and augment natural recruitment, captive breeding programs have been established on the four affected islands. Because disease was suspected as contributing to the decline, a collaborative disease surveillance program was initiated. An infectious disease survey conducted prior to the decline indicated that island foxes were immunologically naive to important canine pathogens, so it became important to determine their more recent exposure to these agents. Their isolated, small population structure makes the island fox particularly vulnerable to disease outbreaks from novel pathogens introduced to the islands from nonendemic species, such as domestic dogs, feral cats and pigs. The vulnerability of the island fox to disease was realized in 1999 when a canine distemper virus (CDV) outbreak caused a rapid, catastrophic decline of the Santa Catalina Island population. To better understand current disease threats to the island fox, a multi-island serologic survey for selected infectious diseases has been initiated to augment the pathology survey. Also, juvenile foxes released from captivity are being monitored to determine if their health status changes post-release. These studies will aid in developing management plans for population recovery that may include use of recombinant CDV vaccination to avert another epidemic.

3. Emerging Diseases in Marine Ecosystems: Protozoal Encephalitis in Sea Otters

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In 1998 we initiated a study of protozoal infections in southern sea otters (*Enhydra lutris nereis*). Two parasites, *Toxoplasma gondii* and *Sarcocystis neurona*, were associated with brain inflammation (encephalitis) in this threatened carnivore. Molecular and antigenic characterization revealed no significant differences from protozoa affecting terrestrial animals and humans. Infective parasite "eggs" are shed in the feces of cats (*T. gondii*) and opossums (*S. neurona*). Because of their apparent terrestrial origin, we expected to detect few natural protozoal infections. However *T. gondii* and *S. neurona* were detected in 36% and 4% of otters, respectively. Sera from free-ranging otters from California, Washington and Alaska were screened for *T. gondii* exposure. Thirty-six percent of California otters were seropositive, compared to 38% of Washington otters and 0% of Alaskan otters. To investi-

gate factors contributing to the apparent marine emergence of *T. gondii*, we compiled spatial, environmental, demographic and serological data from 223 otters sampled in 1997–2001. These data were examined for associations with *T. gondii* seropositivity, with the ultimate goal of identifying risk factors for *T. gondii* infection. Spatial analysis revealed clusters of seropositive otters at two coastal locations, and otters sampled near maximal freshwater runoff locations were 2.9 times more likely to be seropositive than otters from low-flow areas. This study provides specific evidence of contamination of the marine environment with the terrestrial pathogen, *Toxoplasma gondii*. It provides statistical evidence implicating land-based surface runoff as a source of otter exposure, and it is a convincing illustration of pathogen pollution in the marine ecosystem.

4. Avian Vacuolar Myelinopathy in the Southeastern United States—an Emerging Neurologic Disease of Bald Eagles

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Since its initial discovery in bald eagles (*Haliaetus leucocephalus*) at DeGray Lake, Arkansas in 1994 and 1996, avian vacuolar myelinopathy (AVM) has been confirmed in more than 80 eagles found dead in or near eight lakes in four states (Arkansas, North Carolina, South Carolina, Georgia). The disease has also killed thousands of coots (*Fulica americana*), several waterfowl species and most recently a great horned owl (*Bubo virginianus*) and a killdeer (*Charadrius vociferus*). Affected eagles were observed overflying perches and crashing into rocks, and, so far, all have died. The disease is characterized by a microscopic lesion in the brain and spinal cord that is suggestive of a toxic process, but unfortunately, the cause of AVM has not been identified despite extensive diagnostic testing at several laboratories. Using sentinel coots and mallards (*Anas platyrhynchos*), it was determined that AVM is seasonal, site-specific, i.e. acquired at the location where sick and dead birds are found and its onset is fairly rapid, occurring in as little as five days after placement in the lake. However, numerous feeding trials with various food items have failed to determine the source of the agent for these birds. Red-tailed hawks (*Buteo jamaicensis*) fed tissues from affected coots developed the characteristic brain lesion, thus, it is likely that eagles acquire AVM through secondary poisoning from consumption of affected prey, presumably sick coots or waterfowl.

WHALES AND DOLPHINS

Moderator: Bernd Würsig, Texas A & M University

1. Going With the Floe: Killer Whale Specialization and Speciation in Antarctica

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When is a killer whale (*Orcinus orca*) not a killer whale? In the eastern North Pacific, dietary specialization observed among sympatric populations of killer whales indicates the presence of two eco-types: fish-eaters and mammal-eaters. The morphological, ecological and social divergence between these forms is also reflected in their genetic divergence, as measured by fixed differences in mitochondrial sequence data. Examination of killer whale sequences from different ocean basins suggests that this phylogenetic dichotomy is maintained on a global scale. Our field research, along with a review of published data and photographs indicates that two, and possibly three, distinct forms of killer whales occur in Antarctica. These include an open water form that feeds on marine mammals (mainly minke whales) and a form that inhabits the pack ice and feeds on fish. (Too few observations have been made of the third form to make generalizations). We analyzed sequences of 34 biopsy samples from Antarctic killer whales and incorporated them into a global data set. The results indicate a pattern of genetic variation consistent with eastern North Pacific populations; determining whether this also represents species level differences will require additional information on ecological and morphological characteristics. These studies have important implications not only for clarifying the role of killer whales in marine food webs, but also for informing decisions on fishery interaction issues and killer whale conservation in general.

2. Organochlorine Contaminant Levels in Eastern North Pacific Killer Whales

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Killer whales (*Orcinus orca*) are long-lived, top-level marine carnivores with mean life expectancies of approximately 40 years. Several populations of eastern North Pacific killer whales have been the focus of extensive research for nearly 20 years. Individual whales can easily be recognized based on dorsal fin shape and pigmentation patterns. Long-term studies have documented killer whale age and sex structure within selected pods. Three killer whale eco-types have been described and termed "resident," "transient" and "offshore" whales. These eco-types differ in various aspects of morphology, behavior and prey preferences. From 1994–2001, biopsy samples were collected from 89 killer whales located in various geographical areas, ranging from the Bering Sea, Alaska to central California and were analyzed for selected PCB congeners and other organochlorines (OCs). Concentrations of Σ DDTs and Σ PCBs in the killer whales (based on wet weight) ranged from 29–580,000 ng/g and 41–130,000 ng/g, respectively, with California animals containing the highest levels. OC concentrations in transient killer whales were much higher than those found in resident or offshore whales. Certain life history parameters such as sex, age and reproductive status also influenced the concentrations of OCs. Reproductive females contained much lower OC levels than concentrations found in mature males in the same age class or juveniles. Contaminant concentrations found in this study will be compared to the levels reported for other marine carnivores. Furthermore, we will compare OC levels in killer whales to levels associated with deleterious physiological effects in various mammalian species.

3. Predation Rate and Prey Preferences of Southeast Alaskan Transient Killer Whales

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Killer whale (*Orcinus orca*) predation has been implicated in the decline of harbor seals (*Phoca vitulina*), Steller sea lions (*Eumetopias jubatus*), sea otters (*Enhydra lutris*) and beluga whales (*Delphinapterus leucas*) in western Alaska. Until now, calculations of predation rates for cetaceans have rarely been attempted due to inherent difficulties in maintaining contact with the predators and the lack of prey remains following a kill. Empirical data on prey preference is rare even for terrestrial studies, yet both rate and preference are vital to describing predator-prey relationships. Between 1991 and 2001, killer whale surveys were conducted each year throughout the inland waterways of southeast Alaska. Utilization of a dedicated research vessel over the 11-year period provided us with the unique opportunity to follow killer whales over extended periods of time. Here, we present empirical data on transient killer whale predation gathered during 266.5 hours of direct observation representing 33 predation events. Based on these data, a predation rate of 0.8 prey items/24-hour period/whale was calculated. Transient killer whales targeted several species of marine mammals and sea birds. We compare predation rates of killer whales with data from the literature on terrestrial group-hunting species and discuss whether optimal foraging theory applies to killer whales. This is the first attempt to quantify predation rates of any marine mammal through continuous and direct observation of predatory behavior. Information presented here will hopefully contribute to assessing the impact that killer whales may be having on marine mammal populations in western Alaska.

4. Interactions Between Dusky Dolphins and Other Marine Mammals in New Zealand

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Like many animals, dolphins form mixed-species groups, often when there is a high degree of overlap in preferred habitat and when participants benefit through enhanced foraging or predator avoidance. Dolphins engage in mating, care giving and even stranding with heterospecifics. Interactions between dusky dolphins (*Lagenorhynchus obscurus*) and other marine mammals in New Zealand were documented from 1997–2001. In Kaikoura, New Zealand, where dusky dolphins forage at night, associations with common Hector's dolphins (*Cephalorhynchus hectori*) and southern right whale dolphins (*Lissodelphis peronii*) follow seasonal changes in the degree of niche overlap between species, in which water temperature, distance from shore and water depth are likely important factors. Dusky dolphins are more numerous in mixed pods, presumably providing protection from predators for the other species. Interspecific mating between dusky and common dolphins and mixed nursery pods of dusky and Hector's dolphins occur regularly. Dusky dolphins respond to killer whales with a variety of strategies including predator assessment, harassment and evasion. Dusky dolphins also interact with large groups of long-finned pilot whales and bottlenose dolphins. Despite a high degree of range overlap in Kaikoura, dusky dolphins and sperm whales are rarely found in close proximity. The dolphins occasionally engage in play with these resident animals as well as other sporadic visitors, including Southern right whales (*Eubalaena australis*) and humpback whales (*Megaptera novaeangliae*). Interactions with New Zealand fur seals (*Arctocephalus forsteri*) are most consistently observed in a foraging context in the Marlborough Sounds, but also occur during resting/play periods in Kaikoura. Interaction with heterospecifics is a regular, and possibly important, feature of the social lives of dusky dolphins.

5. Behavioral Ecology of Insular Spinner Dolphin Population: Implications for Conservation and Management of the Northwest Hawaiian Region

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Spinner dolphins (*Stenella longirostris*) commonly use inshore island habitats for daytime rest and social interactions and forage over deep waters at night. In the Hawaiian region, they are distributed throughout the archipelago, and at different locations demonstrate differential social behaviors. Off the main islands, they live in fluid fission-fusion societies, with great day-to-day lability in group sizes and interindividual associations. In the remote northwest Hawaiian atolls, however, they occur in much more stable units of associations with strong geographic and social fidelity, no obvious fission-fusion and limited contact with other populations. These differences correlate with geographic separation and habitat variation. In the main islands there are several daytime resting places available; but in far-western Hawaii areas of suitable habitat are separated by large geographic distances, which seemingly prevent spinner dolphin subgroups from moving between different locations. With deep-water food resources in close proximity, it is energetically more effective in the remote western atolls to remain “at home” than travel to other atolls. Thus, there is social stability instead of variability, and there is no fission-fusion effect. This pattern is likely to prevent interbreeding and consequently affect the genetic structure of the Hawaiian spinner dolphin population throughout the archipelago. If the atoll-dwelling spinner dolphins are genetically distinct, they are potentially vulnerable to negative environmental pressure, either natural or human-imposed, and each atoll population (stock) should be managed separately. This should be considered in the conservation planning of the newly-established Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve.

6. Harbor Porpoise Interactions with Selective Salmon Fisheries in Southern British Columbia

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Harbor porpoise (*Phocoena phocoena*) are incidentally caught throughout their range by commercial net fisheries due to their inshore distribution and reliance on commercially important prey species. In British Columbia (BC), few quantitative studies have been undertaken to understand the biology, ecology or fisheries interactions of this species. The goal of our study was to determine the level of incidental mortality of harbor porpoise in the 2001-selective salmon (*Oncorhynchus sp.*) fisheries of southern BC. Incidental catch data were collected directly and indirectly through the Federal Fisheries Observer Program and a license holder questionnaire. Observers in two licensing areas (5% per area) reported four small single phocoenids incidentally caught in gill nets, within a one-month period. Mortality was 50%. Requests to 979 license holders yielded a 27.6% return rate, with 11.7% of the respondents reporting incidental catches of harbor porpoise. Ten of the 19 harbor porpoise reported caught from 1997–2001 were alive and released. Incidental catch and mortality rates were estimated for each data set and suggested that fewer than 100 harbor porpoises are killed each year by commercial salmon gill net fisheries in British Columbia. Recommendations to further reduce incidental catch and increase live release rates were classified in four categories: gill net modifications, observer training, rescue and release protocol and biological research.

Area closures or implementation of acoustic net alarms were not recommended due to the poor understanding of harbor porpoise ecology and biology. Mitigative efforts based on license holder collaboration and existing experimental selective fishing techniques were deemed the most promising for a province-wide reduction of harbour porpoise incidental mortality.

CONSERVATION AND MANAGEMENT OF NORTH AMERICAN BEARS

Moderator: Martin Smith, Defenders of Wildlife

1. Perspectives in Grizzly Bear Conservation: Representations From Newspaper and Magazine Articles

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Human perspectives shape alliances that influence how conservation problems are defined and justified. We were interested in how different groups represented the problems and solutions of grizzly bear conservation in the contiguous United States. We compiled and analyzed 504 quotations from 230 individuals interviewed by journalists during 2000–2001. Additionally, we sorted individuals into logical groups representing different interests. Quotations were reported in local, regional, and national newspaper and magazine articles. To the extent the information was present, we encoded for each quote how the individual described and explained the conservation problem, what solution they offered and how they justified the solution. We also judged whether, *in toto*, the quote was neutral or was supportive or not supportive of a precautionary approach to grizzly bear conservation. Based on mark-recapture methods, we estimated that the 230 quoted people were drawn from a population of about 18,800 people substantively involved with grizzly bear conservation in this region. About equal numbers of quotes supported, were hostile toward, or neutral to a precautionary approach to grizzly bear conservation. The most commonly identified thematic issues were “not enough state control” (20%), “not enough morality or initiative on the part of other participants” (20%) and “not enough bears or bear range” (21%). Regional politicians, political appointees to state and federal management agencies and supporters of commodity interests consistently clustered together in terms of the issues identified, the solutions proposed and the justifications offered. Commodity interest groups and politicians or political appointees appealed most often to fear, personal rights or personal enjoyment. Agency managers and scientists appealed most often to rationality. Environmental interest groups appealed most often to rectitude or existence values. We relate our results to previous hypotheses about alliances and venues of influence in grizzly bear conservation and discuss broader implications.

2. Grizzly Bear Recovery Efforts in the Cabinet-Yaak and Selkirk Mountains Recovery Zones

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The Cabinet-Yaak and Selkirk Mountains grizzly bear (*Ursus arctos*) recovery zones of Idaho, Montana, Washington and British Columbia hold small populations numbering about 30–50 animals in each area. The Selkirk recovery zone extends into British Columbia because of limited habitat within the United States. Limited monitoring programs are ongoing in each recovery zone to provide information on population status, cause-specific mortality and habitat use patterns. Both recovery zones are largely public land administered by the U.S. Forest Service. Public lands are primarily multiple-use lands with small proportions of designated wilderness. Habitat protection efforts have focused on motorized access management to reduce mortality risk and displacement of bears. The Cabinet Mountains were a test site for population augmentation techniques during 1990–1994. Four young female grizzly bears were transplanted to the area from southeast British Columbia. One animal is known to have died, and additional research has been proposed to determine the fate and reproductive contribution of the other animals. Monitoring of radio-collared animals indicates regular movements of bears across the international boundary in both populations. Limited data suggests movements of bears from both populations into a common area in the southern Purcell Mountains of British Columbia.

3. Recovery of Grizzlies in the North Cascades Ecosystem: Obstacles and Opportunities

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The North Cascades ecosystem (NCE) holds tremendous potential for the recovery of grizzlies (*Ursus arctos*) from an ecological and sociological standpoint. Despite this potential, the precarious status of the population and the mandates of the Endangered Species Act, virtually no progress has been made toward the recovery of this extremely vulnerable population. Unlike in the Selkirks and Cabinet-Yaak ecosystems, which also have very small and declining grizzly populations, the NCE has few habitat pressures despite its proximity to the more populous Interstate-5 corridor. I will discuss the legal, political and social reasons for the dire situation of these grizzlies, contrast the problems in different ecosystems and explore international implications and possible remedies. Unless there is swift and decisive action and concerted international effort, extinction of these populations is a distinct possibility.

4. Effects of Human Activities on Brown Bears at Hallo Bay, Katmai National Park and Preserve, Alaska

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Katmai National Park and Preserve (Katmai NPP), Alaska is home to the largest protected population of brown bears (*Ursus arctos*) in the world. Human activity along the coast of Katmai NPP has increased dramatically in the last 15 years. During the summers of 1998–1999, we investigated the effects of this activity, primarily bear viewing and photography, on brown bears at Hallo Bay, Katmai NPP. We used focal and scan sampling to assess the effects of humans on activity budgets, feeding efficiency, habitat use and demographics of these bears.

There was interaction between distance to nearest bear and distance to humans. Humans altered the activity budgets of bears but not all of the effects were negative. Sows with older cubs and single bears were most sensitive to humans. Most negative effects on sows with older cubs and single bears occurred in July. Humans less than 50 m away significantly reduced the grazing efficiency (bites per minute) of sows with cubs. Human presence significantly reduced fishing efficiency (catches per chase) for large males.

We found that the number of bears present on the study site did not change with humans present but use of the area may shift to times of lower human activity. We also found that habitat use did not change when humans were present.

Park managers will probably have to consider controls on human use of the coast of Katmai NPP if human activity in the area continues to increase.

5. The Florida Black Bear: Reducing Risks and Reaching for Recovery in a Rapidly Urbanizing State

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The Florida black bear (*Ursus americanus floridanus*) once inhabited the entire state of Florida but now exists in relatively isolated populations primarily on federal public lands and adjacent state and private landholdings. Florida experiences high rates of human immigration and tourism resulting in suburbanization, road proliferation, intensive recreation and the associated degradation of designated conservation areas. Efforts to protect the Florida black bear include identifying, acquiring and managing essential habitat; improving state and local transportation plans; building a "Be Bear Aware" program to help eliminate the conflicts with people that create "nuisance" animals; expanding outreach to target rural communities and private landholders, students, adults and the media; advocating for state agency staffing and funding and improved growth management policies and economic benefits analyses for conservation lands; and developing a state black bear conservation strategy.

6. Reproduction in Female Black Bears: Monitoring Pre- and Post-Natal Development in Cubs

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Black bears (*Ursus americanus*) exhibit delayed implantation in which the embryo develops to the blastocyst stage then enters a diapause state for 145–165 days. After this period of dormancy, the embryo implants and development continues until parturition in January or February. Previous studies on reproduction of black bears have focused on predicting parturition date through analysis of plasma levels of progesterone or profiling plasma protein. Few studies have examined fetal development and survival because of difficulty in obtaining the necessary data. Studies that have documented fetal growth have been limited to post-mortem examination of reproductive tracts and fetuses. A noninvasive alternative is the use of ultrasonography to monitor fetal growth and development after implantation has occurred. During 1997–2002 we used transcutaneous ultrasonography on 33 bears at the Center for Ursid Research in Blacksburg, Virginia. We used ultrasound every ten days from December 10 to birth to first look for an amniotic vesicle then measure crown-rump growth for 65 cubs. After birth, we recorded morphological parameters of cubs every ten days. Final results will include information on pre- and post-natal growth, prediction of birth date, documentation of pre- and post-natal mortality and the effects of environmental and physiological factors on all these parameters. Ultrasound imaging offers new opportunities regarding reproductive biology in bears, especially for learning more about pregnancy-associated abnormalities, embryonic and fetal death and the effects of body condition on adjustments in reproductive effort.

CARNIVORES AROUND THE WORLD

Moderator: William Burns, American Society of International Law

1. Conservation and Ecology of the Liberian Mongoose in the Swamp Forests of the Ivory Coast

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The Liberian mongoose (*Liberiictis kuhni*) was described from bones discovered in Liberia in 1959; however, its continued existence was not confirmed until 1989. Although it is listed as number one priority for conservation of small carnivores by IUCN, no field studies had been conducted on this species and nothing was known of its ecology. During a ten-month study in the rainforests of Tai National Park, Ivory Coast, the ecology and behavior of this species was studied by direct observation facilitated by radio telemetry. The Liberian mongoose is diurnal and social, living in groups of four to six individuals. Swamp forest and riverine habitat are used almost exclusively for foraging and may be critical for their survival. Scat analysis and behavioral observations conclude that the Liberian mongoose is an earthworm specialist, earthworms making up over 90% of the diet. Family groups commonly plough up large areas of topsoil while foraging, considerably altering the surface of the ground. Transect data suggest that mongooses in this area create an average of 16,700 foraging scrapes per day per km² during the wet season. The effects of this soil disturbance on seedling recruitment were examined. A habitat selection model was made to predict foraging site selection. Potential impacts of foraging on seedling recruitment and mortality were investigated through exclosure experiments, germination tests and direct observation. By increasing litter heterogeneity, removing surface roots and stirring up the seed-bank, mongooses differentially affect seedling establishment and mortality. Their foraging activities are particularly important for successful germination of large seeds. Results suggest that disturbance by the Liberian mongoose may ultimately affect plant species composition and may increase biodiversity.

2. Conservation of Grassland Carnivores in Chihuahua, Mexico

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Worldwide, grasslands are among the most threatened and least protected ecosystems, and Mexico's grasslands are no exception. To date, no reserve has been set up in Mexico with the specific purpose of protecting grasslands. The grasslands of northwest Chihuahua are among the most important on the continent mainly because they include an extensive complex of prairie dog (*Cynomys spp.*) towns, one of the few large enough to accommodate black-footed ferret reintroduction, which was initiated in the area in fall 2001. Many species of carnivores depend on or benefit from prairie dogs, but prairie dogs are being lost to poisoning and agricultural development. After the prairie dogs disappear, mesquite and other woody plants rapidly invade the grassland turning it into a scrub and homogenizing the landscape. We have been monitoring carnivore abundance in prairie dog towns and mesquite scrub and found differences in abundance and richness between both vegetation types. This has important implications related to the expansion of mesquite: Some carnivore species considered at risk in Mexico become less abundant as the mesquite scrub expands, while more common species benefit from the expansion, affecting the survival of other species in a few cases. Black-footed ferret conservation justifies the conservation of prairie dogs and grassland. Ongoing conservation efforts include legal protection, education and participation from local people.

3. Raptor Electrocutions in Power Lines in Mexico: A Diagnosis and Perspectives for Solution

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Raptor electrocution is a worldwide problem which is increasing with growing energy needs. Countries such as the United States and Spain have been working on this issue for many years, but the magnitude of the problem in Latin America is unknown. In Mexico just two cases of conflicts between raptors and power lines have been reported: osprey (*Pandion haliaetus*) electrocution and nest building in power poles in Baja California, and raptor electrocution on the continent's largest prairie dog (*Cynomys spp.*) complex in northwest Chihuahua. The extent of the problem in the rest of the country has not been studied. In an unprecedented effort in Mexico, several NGOs, government agencies and the government utility company gathered for a workshop to start working together to assess the scale of raptor electrocution in Mexico and search for solutions. The outcome of the workshop was the creation of a multidisciplinary committee to work on the problem, the identification of actions to be taken in the short-, mid- and long-term and the identification of needs and opportunities for research, communication, training, funding, power line retrofitting, legislation and international cooperation especially with the United States. We expect that our experience will stimulate the involvement of other Latin American countries in resolving this issue.

4. Coexistence of African Wild Dogs with People in Northern Kenya

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The African wild dog (*Lycaon pictus*) presents one of the most serious challenges for carnivore conservation. An endangered species, wild dogs have been extirpated from most of their historic range and have even disappeared from most of Africa's protected areas. Their decline has mostly been caused by persecution aimed at protecting both livestock and highly valued wild antelope. Because wild dogs live at low densities and range very widely, most of those living in all but the largest protected areas also travel beyond reserve borders where they come into conflict with people. This conflict frequently involves wild dogs being killed and is sufficiently severe to have apparently caused many extinctions of nominally protected populations. Therefore, reducing this conflict and, hence, wild dog mortality is a high priority for wild dog conservation.

Wild dogs living outside reserves in Samburu and Laikipia Districts, northern Kenya, killed far fewer livestock than did other predators (lions, leopards, hyenas). However, when they did attack they often took multiple animals and their impact on individual livelihoods was sometimes severe. Wild dogs killed livestock primarily where wild prey had been virtually extirpated. Traditional Maasai and Samburu livestock husbandry—in particular, the presence of herdsmen—was effective in dissuading wild dogs from killing livestock. Despite occasional losses, most people support wild dog recovery in the area, because they hope it will encourage tourism and increase income at community lodges.

5. Mountain-Dwelling Ethiopian Wolf Population Status and Conservation Challenges

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The highlands of Ethiopia are among the most densely populated agricultural areas in Africa. The Ethiopian wolf (*Canis simensis*), a rare afroalpine specialist, has a fragmented distribution across the mountaintops of Ethiopia, limited to “islands” surrounded by human settlements and barley fields. A comprehensive survey of the highlands yielded detailed information of species distribution, quality and extent of remaining habitats, and threats to population persistence. Seven isolated populations of Ethiopian wolves were confirmed to occur across the entire species range, including two previously undescribed populations. While total estimates did not differ from previous numbers of around 500 wolves, the existence of several small populations significantly changed the overall species status. One population was confirmed extinct in historical times, while two recent local extinctions in small habitat patches were apparently caused by habitat loss due to high altitude agriculture. With an ever increasing degree of contact and conflict between wolves and humans utilizing diminishing Afroalpine resources, transmission of rabies from domestic dogs has become an important threat to all extant populations. Still, wolves survive in almost every patch of remaining Afroalpine in the country, and local populations affected by rabies in the Bale Mountains are recovering. In view of the new information available, we review the status of the critically endangered Ethiopian wolf and evaluate conservation actions, which include specific management strategies for each population.

6. Climate Change and Its Potential Impacts on Carnivores

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In its most recent assessment report, the Intergovernmental Panel on Climate Change (IPCC) projected that global temperatures will rise an average of 1.4–5.8°C by the end of this century as a consequence of the buildup of greenhouse gases related to anthropogenic activities. Temperature increases of this magnitude, as well as other associated indicia of environmental change, are likely to pose grave threats to the world's biodiversity, including carnivore species. The purpose of this paper is to assess the potential impacts of climate change on carnivore species over the next century. In this pursuit, the paper will outline: 1) The most likely scenarios for climate change in the next two centuries in terms of the most relevant indicia for carnivore impacts, those being temperature increases, changes in precipitation and changes in the incidence and intensity of violent weather events, 2) the likely impacts of such changes on terrestrial and aquatic carnivore species, including both direct impacts and possible ecosystem trophic cascades, 3) potential adaptive and mitigation responses, including the role of the United Nations Framework Convention on Climate Change and 4) a suggested agenda for future research.

POSTERS

Dead Sea Otter Drift and Recovery in Central California

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Determining the rate at which dead sea otters (*Enhydra lutris*) strand following death from oil contamination will be important to the damage assessment process. We constructed dead sea otter dummies from half car tires. We released sea otter carcasses and dummies at a one-to-one ratio in 15 batches totaling 66 drift targets over a two-year period. All drift targets were released into the water near the same spot off the end of the Monterey Peninsula. Although carcasses and dummies had highly variable drift patterns, they did not drift significantly differently from one another. Wind appeared to be the dominant factor driving drift, with targets generally drifting directly with the wind. The most common outcome following release was for targets to strand in the immediate vicinity within three days. This commonly happened within 24 hours when onshore winds \geq 10 knots were blowing at the time of release. Light or offshore winds following release resulted in much wider dispersion. In 12 of 15 releases, 100% of our targets stranded. In one release none stranded. Overall, 79% stranded. Three carcasses that did not strand were documented because their buoyant, pressure-resistant transmitter(s) stranded. We also separately monitored two tethered floating sea otter carcasses until they disintegrated. We cautiously predict that in central California waters most freshly dead adult sea otters will float for approximately 40 days before rotting results in lost buoyancy and sinking.

Extirpation and Reintroduction of Fishers in Oregon: Implications for Their Conservation in the Pacific States

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Prior to extensive European settlement, the fisher (*Martes pennanti*) occupied most coniferous forest habitats in Washington, Oregon and California. Subsequent overtrapping, poisoning and habitat loss resulted in the extirpation of fishers throughout much of their historical range in the Pacific states. Among these states only Oregon has attempted reintroductions of fishers: 24 were translocated from south-central British Columbia in 1961, and 41 from B.C. and Minnesota from 1977 to 1981. To document the current distribution of fishers in Oregon, we sent questionnaires to registered trappers and hound hunters and examined records at museums and resource management agencies. We also compiled available information on the geographic locations and results of standardized remote-camera and sooted track-plate surveys conducted in Oregon since 1989. Results indicate that extant populations of fishers in Oregon are restricted to two apparently disjunct populations in the southwestern corner of the state: one in the southern Cascade Range and one in the northern Siskiyou Mountains. Microsatellite DNA evidence supports the hypothesis that fishers in these two regions are genetically isolated. Based on distributional records and morphometric and genetic differences among fishers in this region, we conclude that the population of fishers in the southern Cascade Range is descended either largely or entirely from translocated animals. The loss of fisher populations from central and northern Oregon and throughout Washington has resulted in the isolation of extant populations of fishers in the Pacific states by a distance of 650 km from those occurring in southern B.C. Due to the geographic extent of fisher extirpations in the Pacific states, additional reintroductions may be required to restore fishers to their historical range in this region.

Preserving the Peaceable Kingdom: Investigating the Relationships Between Marine Recreation and Sea Otters in the Monterey Bay

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Monterey Bay is a popular destination for visitors wishing to observe marine wildlife such as dolphins, whales, seals and sea otters. Activities such as kayaking, diving and wildlife watching tours allow people to get closer to these marine mammals and also provide excellent opportunities for environmental education.

In recent years, there has been some concern that these recreational activities may have the potential to disrupt the natural behaviors of the threatened southern sea otter, a species whose numbers are currently declining. Previous research on marine and terrestrial wildlife has shown that human disturbance can have a variety of negative behavioral and physiological impacts. At present there is very little information on the effects of human disturbance on sea otters.

This project is working with local scientists, nonprofits, enforcement agents, tour operators and visitors to investigate current interactions between marine recreation and sea otters. Data is being collected via focal observations of interactions between people and sea otters, comparison of sea otter time activity budgets at various sites in Monterey Bay and through interviews and surveys with all stakeholder groups. The project aims to provide information on the current situation to ascertain if marine recreation is having any detrimental impacts on the sea otter population and to work cooperatively with all interested parties to develop current management strategies such as environmental education programs.

Results of the first field season (2002) will be presented at the conference.

Occurrence, Behavior and Photo-Identification of Killer Whales in Monterey Bay, California

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In the eastern North Pacific, there are at least three ecotypes of killer whales (*Orcinus orca*): residents, transients and offshores. In addition, a fourth type "L.A. Pod," has been identified off California and Mexico. All four types have been recorded in Monterey Bay, California.

Transients were most frequently sighted, occurred in groups of 1–32 individuals, and were distributed in association with the edge of the Monterey Canyon. One hundred twenty individual "transient" killer whales were photo-identified. Foraging strategies and group sizes varied in relation to type of marine mammal prey. Some transient killer whales photographed in Monterey Bay were also sighted from southern California to Southeast Alaska.

The offshore type of killer whale occurred infrequently in Monterey Bay and ranged from 10–75 individuals with the largest groups sighted during winter. Predation behavior on salmon, small schooling fish and a shark was documented. One hundred and ten individuals were identified in this population. Some individuals identified in Monterey Bay were also sighted from Los Angeles, California to southeast Alaska.

The "L.A. Pod" consists of 13 whales that appear morphologically different from the other types and range from the Sea of Cortez, Mexico to the Farallon Islands, California.

The "resident" type of killer whale, specifically the well documented K and L pods that frequent the waters off Washington and Vancouver Island, were sighted on January 29, 2000 in Monterey Bay foraging on salmon. This sighting extends their southern range nearly 1,000 miles from their primary summer feeding locations in the Pacific Northwest.

A Wildland Conservation Assessment for the Central Coast of California

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The central coast of California is a region facing increasing habitat fragmentation because of high population growth rates and agricultural development. As part of its California Wildlands Project, the California Wilderness Coalition conducted an assessment of the unique biodiversity of the region with a focus on mountain lion habitat connectivity. We mapped the distribution of core habitat in the region and used a least-cost path GIS model to assess the potential connectivity between cores based on road density, forest cover and habitat suitability. These analyses of mountain lion habitat framed the backbone of a conservation network for the region to which we added two grassland-dependent focal species, the San Joaquin kit fox and the pronghorn. We then tested the adequacy of using umbrella species to protect finer-scale elements of biodiversity such as threatened amphibians, watersheds supporting steelhead populations, endemic plants and keystone habitats such as oak woodlands and old-growth redwood forests. Because of the extensive habitat needs represented by the focal mammal species, our initial conservation network overlapped with relatively high proportions of most finer-scale elements of biodiversity. Levels of representation of endemic amphibians were inadequate, suggesting that reserve design based solely on carnivore habitat may jeopardize viability of species with narrow habitat requirements.

Suburban Residents' Knowledge of and Attitudes Toward Mountain Lions

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As urbanization spreads into and surrounds wildlands, mountain lion (*Puma concolor*) habitat and movement corridors are reduced and altered by increasing exposure to humans. If humans and mountain lions are to share adjacent landscapes, managers need to understand the public's view toward large predators. In spring 2000, we conducted a telephone survey of local wildlife managers and a mail survey designed to assess 1,000 suburban residents' knowledge of and attitudes toward mountain lions in Tucson, Arizona. We also collected mountain lion sighting reports. Local wildlife managers (n=6 of 9) do not feel that a species-specific management plan for mountain lions is necessary. Two of eight agencies expressed concern about the effect of decreasing prey abundance on mountain lion populations. The overall response rate to the public survey was 52%. Respondents' knowledge of mountain lion biology was low (mean score was 2.5 ± 0.07 out of a possible 7.0). Over 50% of the respondents indicated support for management measures that protect mountain lions in all wildland areas and opposed measures that removed protections. Respondents (76%) indicated an interest in learning more about mountain lion biology and management. We received 419 reports of mountain lion sightings; 101 occurred between 1990–2000 in Tucson and the adjacent mountain ranges. There is local support for mountain lion conservation, and we recommend that educational opportunities for the public be created to inform residents about mountain lion research and management.

Chemical Restraint of South American Coatis with a Combination of Teletamine and Zolazepam (Zoletil®)

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Immobilization of wild animals must be a quick process in order to reduce risk of injuries for both the animal and the staff and to minimize stress, which could negatively affect the animals' health. An effective protocol, including the optimal dose (mg drug/kg body weight), is desirable so that immobilization is achieved in minimum time and lasts sufficiently for safe handling procedures. Zoletil® (Virbac do Brasil), a combination of tiletamine and zolazepam, was used to immobilize free-ranging South American coatis (*Nasua nasua*; n=47) in a field study at Iguaçu National Park, Brazil. The objective of this study was to establish an optimal dose of Zoletil® for coatis that results in safe and successful chemical restraint allowing sufficient time for collection of samples and data—about one hour for our protocol. Regression analysis was employed to obtain a model that predicts the time of effective handling (EH: time elapsed between injection of the drug and first signs of recovery from chemical restraint). Variables tested for their influence on EH were age, body size (kg), sex, reproductive status (pregnant or not), amount of drug (mg), and dose level (1: ≤ 6.0 mg/kg body weight; 2: 6.1–8.0 mg/kg; 3: 8.1–10 mg/kg; 4: >10 mg/kg). The results indicate that body size and dose level (1–4) help predict EH. Recommended dose levels are 2 (means: 7.2 mg/kg) and 3 (means: 8.7 mg/kg), which result in an average handling time of 56 and 61 minutes respectively.

Interactions Between Bears and Humans Along the Chilkoot River in Haines, Alaska: Using the Present To Plan the Future

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Demand for bear viewing opportunities in southeast Alaska has increased in the past decade because of shifts in the economy toward tourism. Use of the Chilkoot River, a tourist destination in Haines, Alaska, for fishing and bear viewing has increased greatly over this period. Ownership and authority along the river is complex, resulting in a lack of regulation and management. We investigated brown bear (*Ursus arctos*) behavior and bear-human interaction during 2000–2001 along the Chilkoot River. The observational study concentrated on the interaction between bears, salmon and humans, on bear responses to vehicle traffic, identifying critical brown bear habitats and primary access corridors.

Preliminary results of temporal and spatial distribution of brown bears indicate that bears are being displaced by elevated levels of human activity. We collected over 2200 observation hours during three salmon species migrations between July and October. As human activity increased throughout the morning, bear activity decreased and bears generally returned near dusk. The exception was two subordinate sub-adult bears who became tolerant of human activity after obtaining human food and allowed visitors to approach within distances of five meters.

In response to the dramatic increases in tourism, the Haines community has convened a working group to develop a management plan for the Chilkoot River corridor. Incorporating the data from this study into the management plan and evaluating the plans success will help to provide humans with safe viewing opportunities while protecting bear habitats and access routes to critical food sources. Once complete, this management plan and its evaluation will serve as an example for tourism-dependent communities challenged with similar issues.

Use of Artificial Dens To Conserve Endangered San Joaquin Foxes

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The installation of artificial dens is a common requirement to mitigate for the destruction of natural dens used by endangered San Joaquin kit foxes (*Vulpes macrotis mutica*). Furthermore, installation of artificial dens may be necessary to provide cover for kit foxes in areas where populations are recovering or in reintroduction areas. A variety of artificial dens have been installed for kit foxes, but rarely has use of these dens by kit foxes been evaluated, and preference by foxes for particular designs has not been assessed. In 2001, we initiated an investigation to examine use of artificial dens by San Joaquin kit foxes. Our objectives are to determine 1) whether foxes will use the dens we install, 2) whether foxes exhibit a preference among den designs or materials and 3) how foxes use the different den designs (e.g., escape, diurnal cover, pup-rearing). To date, complexes of two to three dens have been installed at 11 sites in Bakersfield, California, for a total of 31 dens. Six different den designs have been used. Four different materials were used in the construction of den tunnels, and two different chamber designs have been installed. To date, kit foxes have used at least ten of the dens. No preference has been exhibited among materials or designs. Dens are being used for escape cover and diurnal resting cover.

Vocal Identity in the Swift Fox

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Signals used in acoustic communication often contain identity information about the sender. A receiver may thus be able to obtain information about a sender such as gender and individual identity from cues broadcasted in vocalizations. These types of information can also be useful in species conservation and management when, for example, assessing population structure and size or investigating the behavior and ecology of subgroups in the population that may be important in designing a management strategy. To investigate vocal identity in the swift fox (*Vulpes velox*), variables measured from sound analysis of a presumably long-range vocalization, the barking sequence, were used in a discriminant function analysis on 194 barking sequences sampled from 20 swift foxes housed in large outdoor enclosures at a captive breeding facility during the 1995, 2000 and 2001 breeding seasons. 97.42% of the barking sequences could be classified to the correct sex, and 98.97% of the sequences could be classified to the correct individual. The results of the analysis indicate that this vocalization may be coding gender and identity information, making the barking sequence a candidate for use as a tool in swift fox conservation and suggesting that it may function in transmitting identity information in swift fox communication.

Prey and Fruit Selection in the Diet of the Maned Wolf in the Ecological Station of Itirapina, Southeastern Brazil

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The maned wolf (*Chrysocyon brachyurus*) is the largest canid of South America, and it is endemic to this continent. It inhabits mostly savanna-like and grassland landscapes. Studies on prey and fruit selection in its diet are rare. Some authors have postulated that these wolves are opportunistic in their feeding behavior, but this remains untested. The goal of this work was to gather more information on this subject. This study was conducted in the Ecological Station of Itirapina in southeastern Brazil in the Cerrado region. Fieldwork was carried out during January 1998–February 2000 and August 2001–January 2002. The diet of the maned wolf was studied through the analysis of 171 scats with the aid of reference collections and museum specialists. Scat collection was performed simultaneously with the monitoring of small mammal prey and fruit plants in the study site through pitfall traps and quadrats, respectively. Prey abundance and fruit plant frequencies were compared with the wolf's diet by goodness-of-fit test and Bonferroni confidence intervals procedure. Rodents *Clyomys bishopi*, *Cavia aperea* and *Bolomys lasiurus* were more preyed on than expected by trapping records ($\chi^2=1,082.25$; d.f.=4; $P<<0.0001$). In the same way, fruits like *Solanum lycocarpum* and *Bromelia balansae* were consumed more than would be expected by chance ($\chi^2=298.59$; d.f.=9; $P<<0.0001$). Other small mammals and fruits were either less consumed or in accordance with the expected. These results can be partially explained by specific biological traits of each species, and contradict previous anecdotal postulates on the maned wolf feeding ecology.

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Food Habits of the Syntopic Crab-Eating Fox and Maned Wolf in Southeastern Brazil

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The crab-eating fox (*Cerdocyon thous*) and the maned wolf (*Chrysocyon brachyurus*) are Brazilian sympatric canids. The study aim was the comparative analysis of the diet of both species in relation to frequency of occurrence, number of consumed individuals, estimated biomass consumption and seasonality. The study took place in the Itapetininga Experimental Station in southeastern Brazil in the Cerrado region. Scats of both canids were collected during March 1998–February 2000, resulting in 614 scats of the maned wolf and 82 of the crab-eating fox. Scats were washed through a fine mesh screen and dried. In general, both are omnivorous, with 82 and 118 different species/morphospecies identified respectively for wolves and foxes. According to Levins's standardized niche breadth, their diets are relatively specialized for the high consumption of insects by foxes ($B_A=0.155$) and fruits and small mammals by wolves ($B_A=0.261$). By frequency of occurrence, fruits (44.7%) and insects (59.2%) are the most consumed items by wolves and foxes, respectively. However, mammals represent more than 60% of biomass consumption for each canid. Wolves consumed small mammals and *Solanum lycocarpum* fruits mainly in the dry season and miscellaneous fruits in the wet season ($\chi^2=288.1$; d.f.=8; $p<0.001$). Foxes ate more insects in the dry season and fruits in the wet season ($\chi^2=51.75$; d.f.=5; $p<0.01$). Prey size analysis showed different patterns. The most consumed prey size by wolves was 11–100 g (58.2% of a total of 1,008 individuals), exclusively small vertebrates. Nevertheless, foxes fed mainly on invertebrates (0.1–10 g), representing 97.4% of 2,936 individuals.

Support: FAPESP

The Bush Dog in Northern Brazil: Distribution, Habitat Use and Conservation

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The bush dog (*Speothos venaticus*) remains one of the lesser known neotropical canid. To better understand the species natural history, an assessment was made of its distribution, habitat use and conservation in northern Brazil. Data came from museum collections, field observations and the literature. Results showed that the Parnaíba River would comprise the eastern limit, and that distribution seemed rather patchy. The species was found in lowland and premontane rainforests, and savannas. Contrary to previous thought, this canid did make use of highly disturbed areas. It has been suggested that habitat loss, prey depletion and diseases from domestic animals would pose the main threats. Although there were considerable tracts of theoretically protected areas, their efficacy for bush dog conservation remains unknown.

Little Spotted Cat Distribution and Habitat Association in the Americas

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An analysis of the geographic distribution and habitat association of the little spotted cat (*Leopardus tigrinus*) was performed to better assess the area of occurrence of this poorly known felid. To date, about 250 localities have been recorded, most of which are from Brazil. These records came from museum collections throughout the world, from literature, from field observations and, especially, from live-captured animals. Only reliable records and those with precise location of specimens were used. The coordinates of each locality were correlated with vegetation maps to determine the vegetative life zones associated with the species. Additionally, the altitudinal gradient of specimens and the precipitation levels for the dryer northeast region of the country were also registered for Brazil. The little spotted cat's area of occurrence ranged from central Costa Rica (~10°N) to southern Brazil (~30°S). Records were confirmed for every country within the expected species' range. Little spotted cats were observed in several habitat types, including all major phytogeographic regions in Brazil. These included not only high altitude forests, but also lowland Amazonian rainforest, savanna and semiarid thorny scrub. The species was found in areas ranging from pristine to highly disturbed, even on the outskirts of major cities, and from highly humid to exceedingly dry. Results clearly dismissed the usual literature myth that the little spotted cat is a species restricted to forested habitats.

**Preliminary Results of the Impacts of Excessive
Human Contact on Behavior and Ecology
of a Sub-Population of Maned Wolf
at Serra da Canastra National Park, Brazil**

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The maned wolf (*Chrysocyon brachyurus*) is the largest South American canid and is one of the species that is responding better to human development and disturbance of natural areas among the neotropical carnivores. Ordinarily, it is a solitary animal, but it can be seen in pairs. The adult individuals sustain a home-range of approximately 30 km², where males and females can eventually overlap the using areas. Maned wolves present an omnivorous feeding habit, where approximately 50% of their diet comes from fruits and 50% from animals. The Serra da Canastra National Park in southeastern Brazil is considered one of the areas with largest abundance of this species in the country. Despite high density and frequent overlap of territories, agonistic behavior has not been observed when encounters do occur. In the east portion of the park, where tourist visitation is highest, maned wolves are one of the main attractions. Over the years, park rangers have been feeding several individuals in the park campsite, taming them and allowing close contact with tourists. In the last four years, 5 adults (2 males, 3 females) and 4 juveniles (2 males, 2 females) have occupied this particular area, which comprises about 8 km². Behavioral observations are being recorded for the individuals of this sub-population. Most of the individuals present a relatively tamed behavior. With one exception, all were recorded feeding on tourist food remains. Signs of any of the natural items of their diet have not been detected in most of the feces collected. In addition, three or four animals were seen several times waiting for food by the ranger's base. Further investigations are being conducted to define whether they are interbreeding with members of the same family, or if they are dispersing because of the supposedly intense habitat competition.

Population Expansion as an Effect in the Decrease of Red Wolf Range from 1900–2000

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Historical evidence clearly identifies why the red wolf (*Canis rufus*) was exterminated in the wild, but researchers disagree about the speed and nature of this species' decline. By examining the spatiotemporal patterns of this historical decline, ecologists can suggest strategies that will help to mitigate and alleviate the risk of future species decline. New advances in computer software have made it possible to display and map the spatiotemporal patterns of the red wolf's range. Specifically, this research presents an interactive map, created in Macromedia Flash, depicting the historic range of the red wolf. By overlaying human population expansion, it is also possible to examine and identify patterns that led to the decline of the red wolf range. Textual and visual descriptions of the situations occurring at specific stages over the 20th century are provided as map supplements. The results of this study will be presented in the form of an interactive map. This type of map has the potential to serve as a vital educational tool for wolf studies and other habitat mapping research endeavors.

Evaluation of Wolf Education Centers in the Continental United States

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Historical studies indicate that human activities led to near extinction of the gray wolf (*Canis lupus*). The Animal Damage Control Act passed in 1931 promoted extensive extermination of gray wolves, and by 1973 they were listed as an endangered species. An inadequate understanding of wolves' role in ecosystems as well as false perceptions of their danger to humans led to the widespread destruction of the gray wolf. Educational programs have the potential to alter these perceptions and help restore the gray wolf population to their previous levels. Several wolf education centers in the United States share a common goal of information dissemination about the many benefits of conserving the gray wolf. However, the outreach programs might not be targeting the correct individuals and organizations and reaching as many people as possible. Providing equal access to the information and data from each education center could potentially improve communication and knowledge sharing among interested parties and the general public.

Surveys were used to obtain information about educational outreach, wolf management, staff operations and funding programs of wolf education centers in the United States. Each center's resources are reported, compared and contrasted. The findings will be presented and will be made available for public and educational access.

Distribution and Abundance of Cougars in the Black Hills, South Dakota

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Cougars (*Puma concolor*) historically occurred in South Dakota but were nearly extirpated in the 1900s because of bounties placed on them in 1899. Since receiving legal protection in 1978, the cougar population has become re-established in the Black Hills; however, little was known about the population until recently. We determined the distribution and abundance of cougars in the Black Hills. We captured, immobilized and radio-collared 12 cougars over three snow-seasons (1999–2001) and monitored them weekly from fixed-wing aircraft. We generated 90% Adaptive Kernal annual home range estimates, calculated percent overlap between adjacent male ranges and documented sightings of females and family groups. We constructed a habitat-relation model using geographic information system technology to rank the Black Hills according to its suitability to cougars. We estimated the number of adult breeding animals that occurred on the 8,400 km² mountain range based on mean home-range size, percent overlap and number of adult females occurring in male home ranges. We also generated a population estimate from a population simulation program using the ranked habitat-relation model in conjunction with parameters specific to the area. Mean annual home range size of cougars was males (n=11) 831.0 km²; females (n=7) 152.8 km². Mean annual home range overlap was 15% (4–36.7%) and three to five females were documented in male home ranges. We estimated the Black Hills currently supports a breeding population of 48–72 cougars. Implications for management of cougars are discussed.

Assessing the Conservation Status of a Poorly-Known African Carnivore, the Johnston's Genet

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The rare Johnston's genet (*Genetta johnstoni*) is one of the least known small carnivores inhabiting the West African rain forest. Some new specimens trapped in the field and several rediscovered specimens from collections, have permitted us to reconsider the distributional range of the species. A reassessed distributional map is proposed, extending the previous estimated range 400 km to the west (Kolenté Plates, Guinea) and more than 600 km to the East (Tarkwa, Ghana). The record of a specimen collected in a region of moist woodlands and savannah in Guinea (Kolenté Plates) questions the supposed restriction of the species to dense rain forest habitat. The new map also reveals that island forests scattered throughout the southern zone of Ivory Coast might allow for a continuum between the Guinea block population and the supposed still existent Ghanian population. In the light of these newly collected data (morphology, ecology and distributional range), the endangerment status of the species is evaluated for the first time using IUCN criteria (RAMAS Redlist software).

Color Patterns Among Wolves in Western North America

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We compiled observations from our wolf (*Canis lupus*) research, records from wildlife management agencies, and published accounts to document occurrence and distribution of pelt colors, and changes in individual wolves from black or gray to white. Less than 2% of wolves found in North America from Mexico north through the taiga of Canada are white. The proportion of white wolves increases northward from the taiga through the High Arctic of Canada and Greenland where more than 90% of wolves are white or near white. Wolves that are white as pups probably remain white throughout adult life. Black wolves may remain black or progressively change to bluish-silver, silver or white. Black wolves commonly have a white chest spot and/or white toes that may fade with age. Gray-colored wolves may change to cream or white. Whitening among wolves may be influenced by advancing age, physiological stress and genes.

Jaguar Diets in Eastern Paraguay: Peccaries, Livestock and Other Carnivores

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Jaguar diets (*Panthera onca*) were examined as part of a larger study of mammalian carnivores. Samples were collected from the 64,500-hectare Reserva Natural del Bosque Mbaracayú (RNBM) in eastern Paraguay during the dry seasons (July –September) of 1999, 2000 and 2001. Standardized food niche breadth for jaguars in this study was compared to eight other studies from Central or South America. Standardized food niche breadth from this study is most similar to that seen in jaguars in the Brazilian Pantanal, the nearest comparative study site to RNBM. Collared peccaries (*Tayassu tajacu*) were the most important food item with some white-lipped peccaries (*T. pecari*) also present in the diet. This reliance on peccaries led to relatively low dietary overlap between jaguars and other carnivores at Mbaracayú Reserve. Although rare, there was some evidence that domestic cattle (*Bos taurus*) were consumed. The reserve has become increasingly isolated due to conversion of native habitats to agricultural lands, especially grazing pastures for cattle. As cattle production increases, it is possible that livestock depredation around RNBM will increase. Mammalian carnivores including crab-eating fox (*Cerdocyon thous*), coati (*Nasua nasua*), ocelot (*Leopardus pardalis*) and puma (*Puma concolor*) were also detected in the diets of jaguar at RNBM. While the consumption of fox and coati are likely isolated depredation events, the killing and eating of ocelots and pumas probably implies interference competition. Clearly, jaguars maintain their status as top predator in this area by actively eliminating other carnivores.

An Evaluation of the Potential Threats to Sea Otters Posed by Trap Fisheries

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The growth of the near-shore live finfish trap fishery in central California coincided with the recent decline in the southern sea otter (*Enhydra lutris nereis*) population. Concern arose that this gear might pose a risk to sea otters. We compiled information on incidental take of sea otters by other trap fisheries within the range of sea otters in Alaska and California and demonstrated that sea otters can enter and drown in traps of various design. To determine how sea otters behave in the presence of baited finfish and lobster traps, we exposed orphaned sea otters undergoing rehabilitation at the Monterey Bay Aquarium to these traps in an experimental setting. We have found that most captive sea otters exhibit no reluctance to attempt to enter baited fish and lobster traps and, if the opening is large enough (or the sea otter is small enough), they can and will enter these traps. We have no reason to believe wild sea otters would behave in a grossly different manner.

Things Are Not Always As They Seem: Mortality and the Wildlife Pathologist

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This poster presents two cases which demonstrate that the true cause of mortality in marine mammals is often more complex than superficial gross examination suggests.

The first case was an aged adult male sea otter in excellent nutritional state with a crushed skull. Because the injuries were so massive and localized, severe blunt trauma was suspected. Samples taken during necropsy, however, revealed a high urine concentration of domoic acid (~40,000 ng/ml). (Two days later a seizing sea otter was found at the same site with a domoic acid urine concentration of 364 ng/ml, suggesting that the first animal may also have been seizing.) The crushed skull was the immediate cause of death but was likely inflicted by a "good Samaritan" euthanizing an apparently dying animal on the beach. In addition, *Coccidioides immitis*, a pathogen also dangerous to humans, was isolated from cultures of the colon and spleen. Although infection with this pathogen can cause death in otters, the infection was not yet severe enough to kill this animal.

The second case was an immature male sea otter with severe injuries consistent with boat strike. He had a fractured skull and laceration of the brain, trauma to the chest and abdomen and damage to the liver, spleen, stomach, pancreas and lungs. Microscopic examination of tissue samples, however, revealed significant inflammation of the meninges and brain. *Toxoplasma gondii* was identified by immunohistochemistry and isolated from brain tissue in cell culture. Protozoal encephalitis caused by pathogens including *T. gondii* has been identified as a significant cause of otter mortality and may predispose some animals to shark predation or boat strike.

Evaluation of a High-Density Polyethylene Collar for the Prevention of Coyote Predation on Sheep

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Coyotes have long been a major problem for sheep ranchers in the western United States, and jackals have been a problem for sheep ranchers in South Africa. South African sheep farmers have been able to almost eliminate jackal predation on their lambs by fitting them with King Collars, high-density polyethylene collars that shield the throat. At the ranch of Mr. Joe Broadbent near Evanston, Wyoming, the Department of Animal Science, Utah State University is currently conducting a trial using 900 sheep with collars and 900 without. The short-term objective of the trial is to test the effectiveness of the King Collar against coyotes. If the King Collar proves successful, we could see a reduction in the conflict between ranchers and wildlife conservationists. Ranchers need to produce sheep economically, and conservationists want to avoid the lethal control of coyotes. The King Collar has the potential to protect the lambs, while allowing the coyotes to survive. This should force the coyotes to prey on their natural food, which includes rabbits. This could reduce the rabbit population and thus increase available forage for sheep.

Climate Change and Lynx: Spatial Occurrence Models for Eastern North America

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The Canada lynx (*Lynx canadensis*) was listed as a federally threatened species under the Endangered Species Act in 2000. Knowledge of habitat relations of lynx are based on stand scale associations in Canada and the western United States, and relatively little is known about lynx in eastern North America. Because lynx are extremely mobile, broad-scale habitat associations may be important. We built and tested a spatially explicit habitat model for lynx at a regional scale using data from 7 eastern states and 3 Canadian provinces at a resolution of 1 km². Biologists from this region provided spatially explicit data on 1,150 occurrences of lynx in the Northeast from 1987–1999. Snowfall, road density, bobcat (*L. rufus*) harvest, deciduous forest, and coniferous forest were compared to lynx observations and random locations using logistic regression. Nineteen a priori models were developed using the information-theoretic approach and were ranked using Akaike's Information Criterion (AIC). The snowfall and deciduous forest model predicted lynx occurrences for a reserved data set (n=278) with 94% accuracy. The regions with the highest probability of lynx occurrence were a 67,853 km² area in northern Maine, New Brunswick and Quebec, and a 4,538 km² area on Cape Breton Island in Nova Scotia. Although the listing cited inadequate management for lynx on federal lands, less than 2% of the lynx habitat in eastern North America occurred on U.S. federal land. Relationships among temperature, snowfall and lynx occurrence suggest that climate warming could affect lynx distribution in eastern North America.

Distance Sampling Dilemmas

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Line transect survey methods with distance sampling for animal density and abundance estimates are being used extensively to study diverse species in varying topographical areas. It is often difficult to critically judge the appropriateness of distance sampling for a particular study site, and results may be misleading if conditions do not meet specified criteria. The effectiveness of line transect surveys was assessed for a small resident community of bottlenose dolphins (*Tursiops truncatus*) in West Galveston Bay, Texas starting in 1997. Factors likely to contribute to bias in our study are presented here to help other researchers who are considering line transect surveys better evaluate the usefulness of this technique for their study location and population. In designing transect lines, it is important to take into account known animal movement patterns so that lines do not run through high animal density areas. Topography of the study area may force inappropriate line locations, such as those traversing effective "trails" for the animals. Sample size is determined by the number of lines, weighted by line length. In our study, both the number (less than the recommended 20/stratum) and some short lines were potential problems. Length of time of study must also be considered as more observations are required for particular situations. These include: low sighting frequency, higher sightings close to transect line ("spiked" data) and highly-aggregated population. In our small dolphin community, line transect analysis resulted in positive bias and poor precision, and was deemed impractical for the study area.

The SORAC Center: A Strategy for Sea Otter Research and Conservation

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Subsequent to an extended strategic planning process, the Monterey Bay Aquarium committed to creating a stand-alone facility to house its Sea Otter Research and Conservation (SORAC) program. The new Sea Otter Research and Conservation Center is slated for completion in mid-2004. The decision to create a dedicated research center comes after nearly 18 years of managing sea otter (*Enhydra lutris*) programs haphazardly. For example, the rehabilitation program has relied on facilities that do not meet many of the specific needs of the program, and the emphasis on sea otter research has waxed and waned. The concept of a separate facility involves establishing innovative, collaborative staffing schemes and programmatic systems and building a flexible structure to support rehabilitation, research and conservation activities. A comprehensive description of the conceptual foundation of the SORAC Center, along with internal and external process descriptions, site selection criteria, facility design and construction details, program outlines, and related aspects of the project will be detailed in the presentation to inspire other research and conservation organizations to invest in alternative strategies for addressing their objectives.

Using Frequencies of Social Interactions to Quantify the Hierarchical Structure within a Captive Gray Wolf Pack

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The social dynamics of gray wolves (*Canis lupus*) are not easily observed in the wild because of high pack mobility; therefore current understandings of pack structure are based on the results of captive wolf research. The intent of this project was to determine: 1) whether pack hierarchy can be quantified by frequencies of various social interactions and 2) whether frequencies of dominant and submissive interactions are indicators of abnormal pack tension.

The project was conducted over a three-week timeframe for two consecutive Januaries (2001–2002) at the Grizzly and Wolf Discovery Center in West Yellowstone, Montana. Wolves were observed daily from 830 hours to 1645 hours for 15-minute periods at half hour intervals. Social interactions were scored for initiating and receiving individuals following a list of 23 interactions (Derix and van Hoof, 1995) divided into dominance and submissive classifications. Ratios of interactions per class were calculated and each year's values were comparatively analyzed based on the understanding of a hierarchical system. The pack's alpha female died in between studies, creating an opportunity for comparing the frequency of social interactions among male pack members prior to the breeding season with two different alpha females.

A hierarchical trend was shown to exist, although consistent interaction ratio values for specific ranks would require additional research to confirm and the application of such ratios is questionable, even for captive packs. Statistical differences (where $p>0.02$) were found in 66% of the behavioral comparisons, although definitive conclusions were not reached regarding these variances indicating abnormal pack tension.

Fisher Population Monitoring in the Kings River Adaptive Management Area

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We are examining the population dynamics of a fisher population in the southern Sierra Nevada. Fishers in this region occupy the southernmost extent of this species' range and are isolated from other fisher populations in California by approximately 400 km. Because southern Sierra Nevada fishers are isolated from the rest of the population, there are concerns about the trend of this population. A mark-recapture study in one region of this population will enlighten us about the dynamics of this population as well as allow us to develop an efficient method for monitoring local populations of fishers. We are using two different resighting methods to calculate estimates of survival and abundance. The first involves live capture with camera resight. The other resighting method uses genetic information found in hair. We are noninvasively collecting samples using baited hair snare stations and then genotyping these samples. Each unique genotype is considered a capture for a particular individual. The two resighting methods will be evaluated for their efficiency in monitoring this population. Preliminary surveys have been successful in identifying recaptured fishers using photo stations. We are currently developing techniques for genotyping fisher hair samples.

Mountain Lion Habitat Corridors and Bay Area Regional Planning

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This poster illustrates the need for habitat conservation and regional planning for cougars (*Puma concolor*), a keystone species that plays an integral role in the health of local, regional and statewide ecosystems. The challenge is to maintain land connections between large patches of intact habitat through open communication among county agencies and through regional planning efforts. County borders are human constructs and have no ecological relevance to cougars. It can be assumed certain cougar home ranges overlap California's Santa Cruz, San Mateo and Santa Clara counties, while others may overlap Santa Cruz, San Benito and Monterey counties. Current pressures on land use in Santa Cruz and neighboring counties may affect habitat integrity. By developing land on a project-by-project basis, counties promote habitat fragmentation. Left unchecked, human development in and around Santa Cruz County, for example, will continue to fragment cougar habitat to the point of geographic isolation and the eventual demise of the local population. Maintaining large open tracts of land and providing connections through less hospitable landscapes are critical to ensuring the future health of cougar populations and the wildlife that share their ecosystems. The maps provided will illustrate likely movement corridors for cougars between the Santa Cruz, Diablo and Gabilan Mountain Ranges and areas prone to development in this region.

Mediation of Foraging Behavior and Spatial Distribution of the Alaskan Sea Otter by Harmful Algal Blooms

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By observing sea otters (*Enhydra lutris*), we tested the general hypothesis that the foraging behavior and distribution of high level marine predators under natural conditions are mediated by benthic prey toxicity due to harmful algal blooms. Sea otters in southeast Alaska did change their foraging behavior at sites where butter clams (*Saxidomus giganteus*) were found to contain paralytic shellfish poisoning toxins in high concentrations. At the most toxic sites, sea otters shifted their diet away from their primary butter clam prey to smaller and less abundant nontoxic species. At sites of intermediate prey toxicity, some sea otters continued to forage on butter clams but discarded the most toxic body parts.

DDT and PCB Levels in California Sea Lions

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This study aims to assess current levels of DDT and PCBs in the California sea lion (*Zalophus californianus californianus*), a useful sentinel for monitoring levels of fat-soluble contaminants in the coastal waters of the western United States. These data are of interest because many California sea lions breed in southern California where an estimated 156 tons of DDT residues from dumping in 1948–1970 represent a potential enduring source of contamination. We measured concentrations of tDDT (*p,p'*- DDT + *p,p'*- DDD + *p,p'*- DDE) and PCBs in the blubber of 36 dead California sea lions stranded along the California coast in 2000. The tDDT levels in the blubber of California sea lions decreased by over one order of magnitude from 1970–2000; the decrease in PCB levels was much less evident. The tDDT concentrations were approximately three times higher than PCB concentrations, which is characteristic of California sea lions. The tDDT and PCB concentrations were 150 ± 257 ug/g lipid weight and 44 ± 78 ug/g lipid weight, respectively. There were no significant differences in tDDT or PCB concentrations between animal categories varying in sex or age. The contaminant levels did not vary much between northern, central and southern California. This does not necessarily mean that these three locations are equally polluted, because California sea lions move about widely and feed on mobile prey. Current levels of tDDT and PCBs in California sea lions remain among the highest among marine mammals and exceed those reported to cause immunotoxicity or endocrine disruption.

California Condors of the Colorado Plateau

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This poster documents the behavior and habitat utilization of condors (*Gymnogyps californianus*) in Grand Canyon National Park. Condors spend over 93% of their time roosting, perching and foraging within park boundaries. As of spring 2001, condors laid the first egg in the wilds of Arizona in over 100 years in the upper reaches of Marble Canyon, utilizing cave features similar to those used by condors during the Pleistocene era.

In March 2002, two pairs of mature condors selected facing caves for nesting. Although one nest failed in early May, the other appears to have one condor chick. This poster will focus on nesting condors as well as the issues associated with contaminants such as lead in scavengers. Monitoring and data collection includes human interactions/aversive conditioning, roost/perch site preference and carcass/foraging information.

Assessment of the Conservation Status of Sierra Nevada Red Fox, Pacific Fisher and American Marten in the Sierra Nevada Mountains and Modoc Plateau of California

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In October 2001, the Pacific Southwest Region of the Forest Service undertook preparation of conservation assessments for three rare forest carnivores: Pacific fisher (*Martes pennanti pacifica*), American marten (*Martes americana*) and Sierra Nevada red fox (*Vulpes vulpes necator*) as a result of the Sierra Nevada Framework Record of Decision. For these conservation assessments we are in the process of synthesizing and analyzing the best available information concerning habitat relationships, population status and trends, historic and current distribution, and key risk factors likely to affect the distribution and persistence of each species. Information from the assessments will be used to evaluate the effectiveness of the Record of Decision in protecting and recovering populations of these rare carnivores, and to set the stage for the development of interagency conservation strategies. This poster summarizes progress on the conservation assessments to date.

Density-Dependent Behavioral Traits Regulate the Recovery of an Ethiopian Wolf Population

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Ethiopian wolves (*Canis simensis*) live in small populations restricted to “habitat islands” in mountaintops across the highlands of Ethiopia. Such small populations are highly susceptible to extinction due to extrinsic factors, mainly habitat loss and rabies and demographic and environmental stochasticity. While wolves are solitary foragers specialized in feeding on rodent-rich Afroalpine grasslands, they live in social units of highly related members where only the dominant female in each group breeds. Long-term monitoring data from the Bale Mountains of southern Ethiopia made it possible to study the processes and factors involved in wolf recovery after a rabies epidemic in the early 1990s. Prior to the outbreak Bale’s wolves were constrained by habitat limitations in a saturated environment; male wolves remained in the natal packs while subordinate females mostly dispersed. Following the rabies outbreak, circumstances rapidly changed from a wolf high density at habitat saturation to a situation of low density, fewer packs and extra resources available. Behavioral traits involved in the formation of new packs played a major role in the dynamics of the recovery. Population growth was regulated by density-dependent variations in short-distance dispersal and reproductive suppression of subordinate females. This natural experiment provided valuable information for the development of predictive models to support conservation and management decisions for all highly threatened populations.

Bridging the Gap: African Wild Dog Ethology, Conservation and Management

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The African wild dog (*Lycaon pictus*) is one of the most endangered large carnivores. This obligate social canid lives in packs in which the alpha pair usually monopolizes reproduction and nonbreeding relatives help care for pups. The size of the breeding population is directly related to the number of packs in the population. Typically, same-sex sibling groups emigrate and join opposite-sex groups to form new reproductive units. Not all attempts, however, are successful. An investigation of the dynamics of pack formation was undertaken during a nine-year study of wild dog behavior, communication and pack dynamics in Hwange National Park, Zimbabwe. The social and life histories of known individuals were recorded. Results suggest that group compatibility can influence whether pack formation attempts are successful and that quantifiable behavior patterns may reliably predict the outcome. Potential application of this research to increase wild dog translocation success, improve zoo conservation programs and animal husbandry and enhance conservation education is discussed to illustrate how ethological studies can contribute to wildlife conservation and management.

Feeding Ecology of the Barn Owl in the Ecological Station of Itirapina, Southeastern Brazil

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The near cosmopolitan barn owl (*Tyto alba tuidara*) is a well-known species. However, in tropical areas like Brazil, few studies of its ecology have been conducted. The aim of this study was a quantitative analysis of the feeding ecology of this raptor, including prey selection. The study took place in the Itirapina Ecological Station in southeastern Brazil. The station is in the Cerrado region, an area of grassland savanna. A sample of 265 pellets was collected from five individuals from August 2001–January 2002. The pellets were individually treated with a 10% NaOH solution for four to five hours, then washed in a fine mesh screen and dried. Small mammal abundance assessed by pitfall traps and pellet collections were conducted simultaneously. Pellet analysis yielded 2,077 individuals and a total of 9,371.1 g of estimated biomass consumption from a variety of prey—both vertebrates and invertebrates. Insects such as termites, katydids and beetles were the bulk of the diet (60.0%) by number of individuals, contrary to the results reported in temperate areas. On the other hand, small rodents (85.7%) were the main item by biomass consumption. A goodness-of-fit test ($\chi^2=46.79$; d.f.=4; $p<0.001$) followed by Bonferroni confidence intervals procedure showed that owls selectively preyed on two of five small mammal species available in the study area. However, the most abundant rodent, the delicate vesper mouse (*Calomys tener*), was also the major item in the barn owl's diet (26.9% by number and 62.0% by biomass). Thus, the owl appears to feed opportunistically on this small terrestrial rodent.

Support: FAPESP, CAPES

Trophic Ecology of the Maned Wolf in Southeastern and Central Brazil

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The maned wolf (*Chrysocyon brachyurus*) is the largest South American canid (20–26 kg), and is classified as “near threatened-low risk” by IUCN. This study’s objective was to give a broad description of the maned wolf’s diet by searching for general patterns in 12 southeastern and central Brazilian areas within the Cerrado region. Scats were collected in eight localities during December 1997 and January 2002. This material was washed, dried and stored before systematic identification, counting and analyses of prey remains by frequency of occurrence. Comparable data from four other localities taken from the literature were also added resulting in a total of 3,912 scats and 12,505 prey occurrences. Some 34–76 different prey species were found per single study site. Wolves showed a omnivorous diet consisting of 39.5–56.5% animals and 43.5–60.5% plants. Small mammals (rodents, opossums, rabbits) were the most important prey ($21.5 \pm 6.4\%$; mean \pm sd). The plant material included essentially fruits ($38.2 \pm 9.6\%$), especially fruta-de-lobo (fruit for wolves) *Solanum lycocarpum* (Solanaceae). Nevertheless, biomass consumption estimates yielded *S. lycocarpum* fruits and armadillos as the bulk of the diet ($49.5 \pm 14.1\%$). The most common animal prey size was between 10.1–100 g ($67.6 \pm 12.2\%$). In the majority of localities, fruits are mainly consumed in the wet season, small mammals in the dry season. Predation on domestic animals was low and restricted to poultry (0–2.2%).

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Caribou and Wolf Migration and Wolf Populations in Tundra and Forest Ecosystems

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Wolf (*Canis lupus*) hunting in the treeline region of northern Canada, an ecological transition zone and hypothesized border region between two distinct wolf populations or subspecies, can be locally intense. Conversely, small numbers of wolves are killed further north in the tundra or south in the boreal forest. Wolves rely on migratory caribou (*Rangifer tarandus*) in the tundra, and on resident prey in the forest. Depending on the relative impact on each of the supposed populations, these wolf hunts may not be sustainable. In addition, some biologists are concerned because of potential overharvesting related to current wolf harvest methods, particularly snowmobile hunting. We captured and fitted 19 wolves and 19 caribou with satellite collars in the tundra to document for the first time long-range migration in wolves as they follow the migrating caribou from the tundra ranges to treeline wintering areas and back. We analyzed this ecological data in combination with morphological and genetic data to conclude that the migrating tundra wolves and the resident forest wolves are not only different populations—they are different Evolutionarily Significant Units (ESUs). Therefore, tundra and forest wolf management conservation should be planned independently.

A Short-Term Diversion Feeding Trial To Reduce the Impact of Coyote Predation on a Federally Threatened Ground Nesting Bird Species

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Research has shown that the diet of coastal coyotes (*Canis latrans*) differs significantly from inland populations, with up to one-half of their diet being composed of food items derived directly or indirectly from the ocean. The frequent use of beaches as foraging habitat during western snowy plover (*Charadrius alexandrinus nivosus*) nesting season results in an increased risk to the nesting success of this federally threatened shorebird. A two-year study of home range sizes and their in an unexploited coastal population of coyotes on Vandenberg Air Force Base, California, indicates that coyotes may be motivated to reduce their presence from beaches through various techniques. We report the results of a short-term trial implemented to assess the potential consequences on territorial boundaries and foraging patterns of coyotes when diversionary food is provided within their home range to reduce foraging in a specific area of their territory.

Effectiveness of a Fladry Barrier in Captive Wolves

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In a recent article, Musiani and Visalberghi (2001) reviewed the historical use of fladry barriers in wolf capture and described a series of experiments in which the effectiveness of fladry was assessed. They reported that no wolves crossed their barriers, but in their tests the barriers were in place for only a short interval of time and for a single trial. We tested the effectiveness of a fladry barrier constructed as suggested by Musiani and Visalberghi to keep two captive wolves away from their food ration. The behavior of the wolves following delivery of food was observed during three trials one week apart to establish a behavioral baseline. The effect of the barrier was then assessed during two test trials one week apart. During the first test trial, both wolves crossed the barrier within one hour; and during the second trial, one wolf crossed it in less than four minutes. Our results suggest that fladry may be effective for short periods, but habituation to the barrier is rapid and the usefulness of fladry in the field as a nonlethal means of predator control is questionable. Behavioral variability of individual wolves in response to fladry and possible effects of captivity must be assessed.

Hunting Behavior Strategy of Mexican Wolves

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In social carnivorous mammal packs, the number of individuals participating in the capture of prey is important. In this way a group of carnivores is able to prey on animals that are in the same weight as the predator group. This hypothesis is explored with Mexican wolves (*Canis lupus baileyi*) in captivity. Fifteen predation events were observed to describe wolf pack hunting behavior strategies. The results showed only the pack males (3 individuals) had physical contact with the prey by means of lunges and bites. The females (2 individuals) collaborated by pursuing and stalking the prey. Physical contact was established and maintained until the prey became immobile. At this stage, all pack members participated in order to kill and consume the prey. This pack hunting strategy allows the group to bring down and kill preys from 70–180 kg. Five wolves were not able to hunt preys weighing more than 180 kg. We also observed a pair of Mexican wolves that was unable to knock down and kill prey weighing 55 kg. There is an optimal number of members, which relates wolf pack size with the prey availability in the geographic range. These results and some behavioral arguments are used to delineate a conservation strategy for this predator in the reintroduction program in Mexico and the southwestern United States. With this knowledge, we can avoid conflicts between human activities, such as cattle-raising, and wolf reintroduction.

Wolves in Maine: A Computer Model

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Based on the potential for wolf recovery in the Northeast, I developed a methodology to assess the effects of gray wolf restoration on ungulate and other predator species in the potential wolf core habitat of Maine. I used a stochastic predator-prey computer model, STELLA which simulated the probable consequences of wolf recovery. This type of modeling is useful in demonstrating the ranges of possible outcomes, but is not intended to predict exact consequences. The multiple simulations indicate that wolf recovery will not result in any dramatic loss of deer density and that the wolf populations will reduce the coyote numbers. Success of wolf recovery will depend in large part on the number of wolves released into a recovery area.

A Review of Short- and Long-Term Effects of Whale Watching on Killer Whales

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A number of cetacean studies have shown that whale watching causes short-term behavioral changes in individual animals, but none have yet demonstrated long-term population effects. This is particularly true of killer whales (*Orcinus orca*). In British Columbia, killer whales have precisely known population dynamics, and there is a well-documented history of whale watching activity. Studies of the effects of vessels on the behavior of northern and southern resident killer whales in British Columbia have been conducted for two decades and have found significant short-term behavioral effects. In general, the interaction studies indicate that killer whales employ a multivariate array of responses to whale watching that is a function of vessel numbers and proximity. Other significant factors may be vessel size, activity and engine noise, as well as age and tolerances of individual killer whales. Further work is needed to assess whether short-term individual behavioral effects can lead to long-term population changes. One line of research that may shed light on long-term effects includes comparative studies of populations over time or across broad geographic ranges (i.e., population dynamics, physiology, behavior, etc.). Another is to develop mathematical models to evaluate possible population effects of whale watching on the energetics and hearing ability of killer whales.

Examining Temporal and Spatial Variation in Gray Wolf Trophic Relationships Using Stable Isotopes

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Boreal forest ecosystems are composed of a diversity of fauna whose interactions are of particular interest to ecologists and managers. Stable-isotope analysis provides a means to investigate trophic relationships among boreal forest animals. We used this technique to investigate trophic dietary patterns in wolves occurring in and outside a protected area (Prince Albert National Park) in the boreal forest ecoregion of Saskatchewan, Canada. We measured stable carbon ($\delta^{13}\text{C}$) and nitrogen ($\delta^{15}\text{N}$) isotope values of hair from 16 mammalian species in order to evaluate potential isotopic inputs to wolf diets. We detected trophic separation and isotopic variation within and among species. Among herbivores, 9 small mammals were separated isotopically from 11 ungulates. Trophic segregation was also detected among carnivores that included 42 coyotes (*Canis latrans*), 2 lynxes (*Lynx rufus*), 11 wolves (*Canis lupus*), 2 fishers (*Martes pennanti*), 1 marten (*Martes americana*) and 1 wolverine (*Gulo gulo*). Seven black bears (*Ursus americanus*) and the coyotes showed large intraspecific variation in isotopic signatures, indicating that some individuals fed high on the food chain, potentially because of access to garbage. Wolves showed low variation in stable-isotope signature indicating dietary similarity among individuals. Our investigations will examine hair and other tissues to evaluate seasonal changes in wolf diet. We will discuss the trophic position of wolves in relation to the boreal forest food web and how stable-isotope techniques can be used to elucidate these and other investigations.

Geographical Distribution of the Andean Mountain Cat and Pampas Cat in the Bolivian Andes

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The Andean mountain cat (*Oreailurus jacobita*) is considered to be the second most endangered wild cat in the world and one of the most endangered wild cats in the Americas. It is also one of the least known cat species in the world.

The Andean cat is easily confused with the pampas cat (*Lynchailurus pajeros*) which is smaller and has a much wider range than the Andean cat. However, the pampas cat is not well known either.

During 1998–1999 and March–October 2001, a field survey was carried out to confirm the presence/absence of both cat species within the high Andean and Puna regions of Bolivia. Field interviews were mainly done during the first phase, and the second phase included intensive searches for direct and/or indirect presence signs. A total of 136 localities were visited, including five protected areas; and 211 records of three types were obtained (verified=35, unverified=127 and undetermined=49).

The results suggest that the Andean cat could be restricted to the high Andean region of Bolivia more than 4,000–4,100 m above sea level, while the pampas cat can be found in both regions—Puna (3,600–4,100 m above sea level) and High Andean. Verified records for Andean cat were the fewest (3.8% of all records), verified records for pampas cat were 12.8% and undetermined records for both species represented 23.2%. A preliminary distribution map of both cat species is presented.

An Evaluation of Fisher Reintroductions in Western Montana

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Reintroductions are an important tool in modern wildlife management, but their success and the success of future efforts depends upon careful monitoring. The value of fishers (*Martes pennanti*) as a predator of porcupines (*Erethizon dorsatum*), as a furbearer and as a charismatic native carnivore have led them to be one of the most widely reintroduced carnivores in North America. It is believed that fishers were extirpated from their range in Montana by the 1920s as a result of fur trapping, predator poisoning and habitat alteration. Although there have been several attempts to reintroduce these large mustelids into Montana, no comprehensive evaluation of these efforts or the status of the species has been conducted, and the demographic and genetic consequences of fisher reintroductions in the state are unknown. We will conduct an evaluation of fisher reintroductions in Montana at two scales. We will carry out a field-based study in the Cabinet region in order to assess the distribution and habitat use of fishers a decade after a reintroduction. Analysis of existing records and genetic work will be used to determine the status and origin of fishers in western Montana. Our objective is to document the distribution of fishers in western Montana and within the Cabinet region. To date, we have completed two seasons of surveys in the Cabinets using track plates, trapping and snow tracking within 18 mi² survey units and begun analysis of statewide records.

Intraspecific Fostering in the Red Wolf

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Fostering individual or multiple offspring from a source litter to a recipient litter has been performed opportunistically in the red wolf recovery program. Fostering offspring was initially conducted in captive situations to determine the effectiveness of this population management strategy. Subsequent attempts were conducted to allow a single pup to derive social benefits of growing up with siblings, to reduce numbers in a large litter or to supplement the wild red wolf population. Eight separate fostering events involving captive-to-captive ($n=6$) and captive-to-wild ($n=2$) litters were attempted from 1987–2002. A total of 14 (range 1–3) pups have been fostered during the reporting period. The average age of pups fostered from the source litter was 10.38 days (range 5–14). Average age of pups in the recipient litter was 9.71 days (range 4–16). The time between removal from a source litter to placement with a recipient litter ranged from several minutes to about six hours. All pups involved in captive-to-captive fostering events survived to weaning. One of two pups involved in a 1998 captive-to-wild fostering event is known to have survived until weaning. Verifying the success of a captive-to-wild fostering event attempted in 2002 will be determined later in the year. The utility of intraspecific fostering has assisted red wolf population management and could provide significant conservation application for recovery in the future.

Hand-Rearing Coyote Pups with Commercially Available Milk Replacers—A Comparison with Mother's Milk

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In numerous situations it is necessary to bottle-feed young animals. These include maternal abandonment, inadequate nutrition, or in research, the desire to augment early experience to assess its effect on subsequent behaviors. With herbivores, the choice for milk replacers is made easier with the availability of milk supplies from domestic animals. Carnivores, however, present a larger difficulty in providing adequate nutrition for optimum growth of young animals. It is desirable to match mother's milk in fat, protein, total solids, lactose and mineral content, but there is little information about the milk composition of wild species. There are numerous commercially available products developed for the rearing of domestic puppies and kittens which could be used as milk substitutes for wild canids and felids. The purpose of this study was to compare three commercially available milk replacers with coyote (*Canis latrans*) milk to determine which product would most closely simulate coyote pup growth with nursing. Coyote pup weights were measured throughout the rearing process and were analyzed using SAS proc mixed with respect to pup age. Data were collected over three rearing seasons with a variable number of individuals per treatment group. From this study, we conclude that Esbilac bitch's milk replacer (PetAg) most closely simulated the growth rate of pups reared on mother's milk.

Artificial Food Sources Alter Distribution and Negatively Impact the Health of an Insular Canid

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Arctic foxes (*Alopex lagopus pribilofensis*) inhabiting St. Paul Island, Pribilofs, Alaska are typically distributed around the island's perimeter near natural food resources. However, recent anthropogenic changes have created artificial food sources resulting in unusually high numbers of foxes in town. Censuses of foxes were conducted prior to and following construction of a breakwater and fishery processing facility in the harbor. Foxes residing in town increased rapidly following establishment of artificial food sources (bait, by-catch, garbage). Increases in the urban fox population were attributable mainly to increased survivorship among juveniles. Tagging revealed that occasionally foxes from outlying areas also foraged in the harbor—a behavior not observed prior to breakwater completion. Concentrations of foxes may cause increased competition and aggression; urban foxes (n=30) showed significantly higher variance in mean body weight ($p=0.05$ males; $p=0.006$ females) than animals residing in outlying areas (n=60). Urban females showed higher incidence of wounds (21%) than females in outlying areas (9%). In town, foxes face elevated health risks including increased exposure to pathogens from garbage and domestic pets and increased human persecution. Control measures aimed at foxes in town may represent an island-wide population sink for this geographically and genetically isolated carnivore.

A Coyote in Sheep's Clothing: Sex Identification of Mixed Species Samples

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There are still untapped sources of genetic material for wildlife studies, some of which may contain DNA from more than one individual. Genetic markers are available to determine species and individual genotype of a sample, and those markers would not usually be compromised in a mixed species sample. However, determining the sex of an individual from a mixed species sample is limited by the available markers which exploit differences between the X and Y chromosomes. These markers can be used to sex a sample from an unknown individual, but many sex-specific polymorphisms do not vary among species so those markers may be uninformative for mixed species samples. Based on DNA sequence information from male and female coyotes (*Canis latrans*) and sheep (*Ovis aries*), novel species-specific sex-specific RFLP markers were identified that allow coyote sex to be determined in mixed samples of both sheep and coyote DNA, regardless of sheep sex. The success of these RFLP markers was compared to that of a canid-specific sexing marker on different mixtures and ratios of coyote-sheep DNA. Sex determination of mixed species samples is possible, but markers must be developed for the potential species combinations.

Diets and Habitat Associations of Bush Dogs in Eastern Paraguay

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Bush dogs (*Speothos venaticus*) have existed as a virtually unknown species in the wild. Despite a reported wide geographic range for the species (southern Panama through northern Argentina), few documented observations exist. In eastern Paraguay, at the southern end of their range, bush dogs are confirmed to exist within the Reserva Natural del Bosque Mbaracayú (RNBM). The reserve contains a remnant of the Interior Atlantic Forest, cerrado and patchy grassland habitats. Bush dogs coexist with at least 15 other mammalian carnivore species at RNBM. All previous information on the species from this location resided within the local and indigenous communities. This noninvasive study relied on detection of feces and tracks in the field as well as molecular and GIS analyses. The diet analysis, based on feces collected and identified by local peoples and later confirmed to be those of bush dog by molecular techniques, indicated bush dogs at RNBM ate mostly vertebrate prey. Small mammals (marsupials and rodents) were the most common prey followed by agoutis (*Dasyprocta azarae*) and pacas (*Agouti paca*). Cecropia fruit also was present in the diet. This is the first documentation of fruit consumption by bush dogs. Bush dog-habitat associations within the RNBM were also evaluated. Bush dog sign occurred mostly in forested, lowland habitats at varying distances from permanent water. Although these results are preliminary, they reveal new insights into the ecology of wild bush dogs in eastern Paraguay.

Habitat Association of Mammalian Carnivores in Eastern Paraguay

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Understanding how animals relate to their environment is critical to developing long-term plans for conservation reserves. The Reserva Natural del Bosque Mbaracayú (RNB), in Eastern Paraguay, contains isolated Atlantic Forest (IAF), a large tract of cerrado and patchy grasslands. The IAF consists of three major forest habitats: low, medium and high. At least 16 mammalian carnivore species inhabit the reserve. Our objective was to evaluate the distribution of mammalian carnivore signs relative to habitat type. Two log-linear models were used to evaluate the presence of carnivore feces, kill-sites, tracks and sightings relative to major habitat types in the reserve. The first model treated habitats as either forested or non-forested while the second used five habitat categories. Several species appeared to occur uniformly in the five habitats. However, a significant interaction between species and habitat ($P < 0.01$) in both models suggested some carnivores selected or avoided specific habitats. We found that jaguars (*Panthera onca*) and pumas (*Puma concolor*) used habitats in proportion to their availability. Margays (*Leopardus wiedii*) and coatis (*Nasua nasua*) appeared to select forested habitats while maned wolves (*Chrysocyon brachyurus*) and raccoons (*Procyon cancrivorus*) appeared to select non-forested habitats. These preliminary results suggest that complex assemblages of carnivores are dependent on diverse habitats. Additional long-term studies of mammalian carnivores in the reserve and their habitat use will provide insight into their ecological needs. This is an essential step in developing conservation management plans for the Mbaracayú Reserve and other South American conservation reserves.



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