27th International Conference On Bear Research & Management

Abstract Guide

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Conference Website
Virtual Attendee Website

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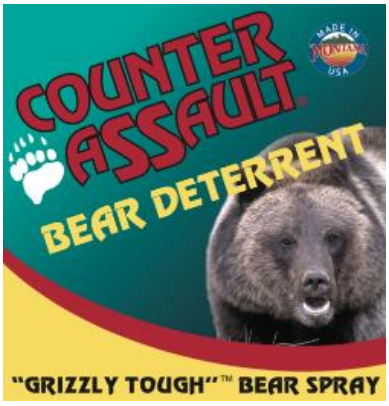

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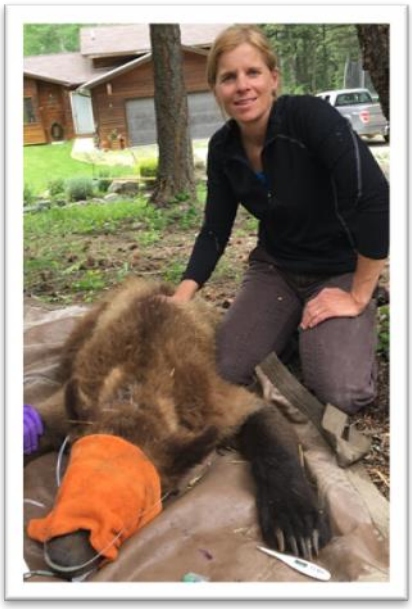
INVITED SPEAKER BIOGRAPHIES

LAURA CONLEE

Laura Conlee is the Furbearer Biologist for the Missouri Department of Conservation (MDC). Laura received her BS from Northern Illinois University and her MS from Southern Illinois University where she studied space use and habitat selection of long-tailed weasels. Laura worked for the Massachusetts Division of Fisheries and Wildlife for 8 years as the Furbearer and Black Bear Project Leader before coming to MDC in 2016. Laura currently oversees MDC's black bear research program, is co-chair of the Large Carnivore Response Team and monitors furbearer and bear populations to inform management decisions. Laura has worked with black bears since 2010 with a primary focus of conducting research to inform management decisions.

HILARY COOLEY

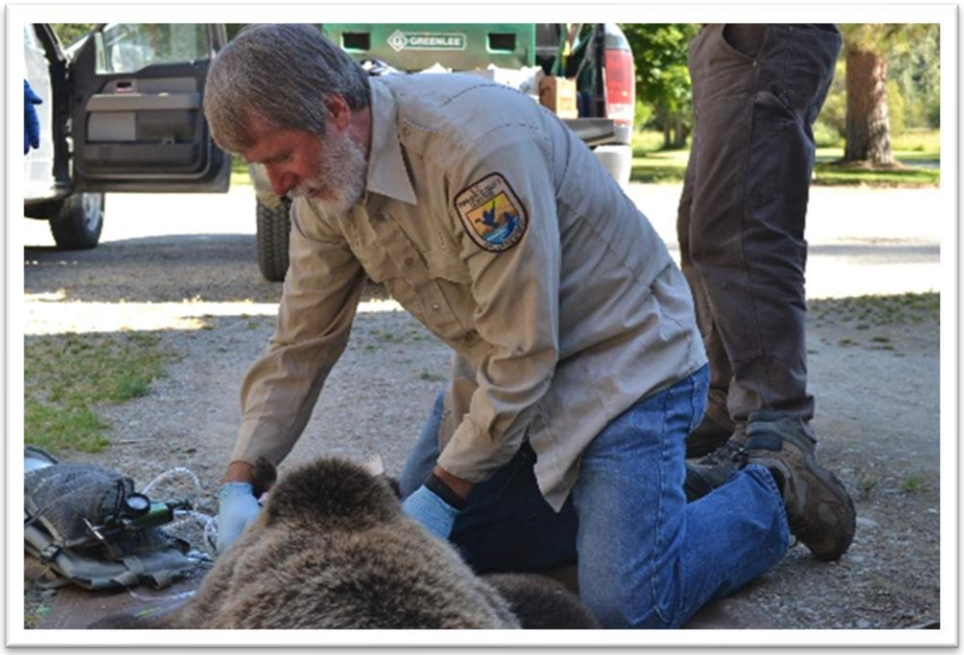


Hilary came on board as the Grizzly Bear Recovery Coordinator with the US Fish and Wildlife Service in March 2017. Previously, she worked for the US Fish and Wildlife Service in Alaska as the Polar Bear Program Lead, and in Idaho as the Wolf Recovery Coordinator for the Northwest Region. She also spent time working for Idaho Department of Fish and Game as a regional wolf biologist. Her wildlife career began working on mountain lions for 7 years in Wyoming and in Washington, where she received a M.S. and Ph.D. in natural resources sciences at Washington State University.

CECILY COSTELLO

Cecily Costello began working as a Wildlife Research Biologist for Montana Fish, Wildlife & Parks in 2015. She supervises the Grizzly Bear Trend Monitoring program in the Northern Continental Divide Ecosystem and is a member of the Interagency Grizzly Bear Study Team in the Greater Yellowstone Ecosystem. Her professional career has been devoted almost entirely to the study of black and grizzly bears, previously working for the University of Montana, Hornocker Wildlife Institute/Wildlife Conservation Society, the New Mexico Cooperative Fish and Wildlife Research Unit, and Western Ecosystems Technologies. She got her BS degree from Florida State University in 1986, her MS degree from the State University of New York College of Environmental Science and Forestry in 1992, and her PhD from Montana State University in 2008. She has been an Associate Editor of the journal Ursus since 2006 and served as Treasurer for the International Association for Bear Research and Management during 2007-2013.

WAYNE KASWORM



Wayne Kasworm (U.S. Fish and Wildlife Service) has a B.S. in Wildlife and Fisheries Resources from the University of Idaho an M.S. in Fish and Wildlife Management from Montana State University, Bozeman, Montana. He has over 35 years of experience in grizzly bear research and management with the U.S. Fish and Wildlife Service and Montana Department of Fish, Wildlife, and Parks. His primary duties include: grizzly bear and black bear research in Montana, Idaho, Washington, and British Columbia, monitoring grizzly bear populations and recovery in the Cabinet-Yaak, Selkirk Mountains, and North Cascades recovery zones, assist in development and implementation of the grizzly bear recovery plan, plan and implement grizzly bear population augmentation in the Cabinet Mountains, monitor bear food production, monitor grizzly bear genetics, and science advisor to the North Cascades and Selkirk/Cabinet-Yaak grizzly bear subcommittees of the Interagency Grizzly Bear Committee.

RICHARD D. MACE

Richard (Rick) retired from Montana Fish, Wildlife and Parks as a Research Biologist in 2016 after a 40-year career conducting field research on grizzly and black bears. Rick received BS and MS degrees in Wildlife Biology from the University of Montana, Missoula, and a PhD from Sveriges Lantbruksuniversitet in Sweden. Rick was Principle Investigator on several long-term field investigations in Western Montana which involved monitoring grizzly bears via telemetry. He studied and published findings on habitat requirements, the impacts of human development including roads, trails, and logging. In 2004 he initiated a large-scale, long-term study of grizzly bear demographics; designed to estimate population trend and other vital population rates from a large sample of radioed females over the entire Northern Continental Divide Ecosystem. That interagency study continues today and is considered the method to monitor grizzly bear populations into the future. Rick also conducted black bear population studies using DNA hair-traps in 9 study areas of occupied black bear habitat in Montana, developed population models for mule deer, and assisted in grizzly bear studies in Denali Park, Alaska. Rick was a member of most interagency committees that dealt with the recovery of grizzly bears under the Endangered Species Act. Rick has lived and worked in Kalispell since 1984.

GARY M. TABOR

Gary M. Tabor, VMD, MES, is an ecologist and wildlife veterinarian based in Bozeman, Montana. In 2007, he founded the Center for Large Landscape Conservation to help people and institutions make better conservation decisions at the scale nature functions.

Tabor has worked on behalf of large landscape conservation internationally for over 35 years with 12 years of experience in Africa, South America and Australia, and 12 years as a leader within the U.S. philanthropic community. He has served with the Geraldine R. Dodge Foundation, the Henry P. Kendall Foundation and, finally, as the Yellowstone to Yukon program director for the Wilburforce Foundation. His work in philanthropy also includes the design of international conservation trusts for USAID and the World Bank. He also co-founded the Australia Environmental Grantmakers Network.

Tabor's conservation achievements include the establishment of Kibale National Park in Uganda, establishment of the World Bank's Mountain Gorilla Conservation Trust, co-founding the Yellowstone to Yukon Conservation Initiative, pioneering the field of Conservation Medicine and EcoHealth, co-founding Patagonia Company's Freedom to Roam wildlife corridor campaign and co-founding the Practitioners' Network for Large Landscape Conservation and the Roundtable of the Crown of the Continent – a three-time winner of the climate adaptation award by the US National Fish, Wildlife and Plants Climate Adaptation Strategy.

Tabor is a recipient of the Australian American Fulbright Scholar award in Climate Change. He is chair of the IUCN World Commission on Protected Areas' Connectivity Conservation Specialist Group. Gary has university appointments and affiliations with the University of Wisconsin, University of Queensland, the University of Montana and Colorado State University.

A lifetime ago - as a veterinary student, Gary worked with Chuck Schwartz, Al Franzman and John Bevins with the Alaska Fish and Game on bear ecology in the Kenai Peninsula.

FRANK T. VAN MANEN

Frank T. van Manen is a Supervisory Research Wildlife Biologist with the U.S. Geological Survey in Bozeman, Montana. He is the Team Leader of the Interagency Grizzly Bear Study Team (IGBST), a cooperative science team of federal, state, and tribal agencies that was established in 1973 and addresses research and monitoring needs regarding the Greater Yellowstone grizzly bear population. Frank earned a M.Sc. degree in Biology from Wageningen University in the Netherlands in 1989 and Ph.D. in Ecology from the University of Tennessee in 1994. He joined the USGS in 2000 and researched black bears, red wolves, and Florida panthers in the southeastern U.S. He moved to Montana in 2012 to join the IGBST. His current research focus is on the changing demographics and ecological plasticity of Yellowstone grizzly bears. Frank has collaborated on bear research projects in Ecuador (Andean bears), Sri Lanka (sloth bears), China (giant panda), and Malaysia (sun bears). He was elected President of the International Association for Bear Research and Management for 2 terms during 2007- 2013 and served on its Council for 15 years.

LIVE PRESENTATIONS

INTRODUCTION TO THE NORTHERN CONTINENTAL DIVIDE GRIZZLY BEAR ECOSYSTEM

Richard Mace

This international bear conference was originally scheduled to occur near the Northern Continental Divide Grizzly Bear Ecosystem (NCDE), allowing attendees to experience grizzly bear research, management and habitat in this area first hand. However, because the conference is now virtual, I would like to take the opportunity to briefly discuss the history of grizzly bear conservation since its listing under the Endangered Species Act in 1975, and overview strategies that have resulted in significant recovery of the population. Several distinct habitat regions in the NCDE and their associated bear management challenges will be discussed. The results from two research projects successfully led to increased knowledge of the size and population trend of NCDE grizzly bears, showing that the population has increased from several hundred the 1970's to over 1,000 at present. Furthermore, the geographic distribution of the population has expanded substantially. In some areas, this expansion has occurred into areas not occupied for over 100 years, and as such is providing both opportunities and challenges to bear managers.

WHERE ARE WE WITH GRIZZLY BEAR RECOVERY IN THE LOWER 48 STATES?

Hilary Cooley[1], Wayne Kasworm[1], Jennifer Fortin-Noreus[1], Justin Teisburg[1], Tom Radandt[1]

[1] US Fish & Wildlife Service

The USFWS listed grizzly bears as a Threatened species in the lower-48 States in 1975 and subsequently designated six recovery zones. Due to the success of conservation efforts and collaboration among a variety of stakeholders, two of these populations (Greater Yellowstone Ecosystem, Northern Continental Divide Ecosystem) have achieved biological recovery goals and the USFWS is working towards delisting. Grizzly bear populations in the CYE and SE are small but growing, and recovery efforts are ongoing. Ongoing grizzly bear range expansion is increasing the potential for connectivity to isolated (GYE) and unoccupied populations (BE). These conservation successes, however, bring significant management challenges as much of the range expansion is occurring onto private land and through human-dominated landscapes. We review the history of recovery, current population status, management issues, litigation challenges, and where we go from here.

GRIZZLY BEAR POPULATION AUGMENTATION IN THE CABINET MOUNTAINS OF NORTHWEST MONTANA

Wayne Kasworm[1] Timothy Manley[2], Kimberly Annis[3], Thomas Radandt[1], Justin Teisberg[1], Chris Servheen[4], Hilary Cooley[5]

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[5] US Fish and Wildlife Service, Missoula, Montana 59812

The Cabinet Mountains grizzly bear population in northwest Montana was estimated at 15 or fewer individuals in 1988 and believed to be declining toward extinction. In response to this decline, a test of population augmentation techniques was proposed and after extensive public input was conducted during 1990-1994. Four subadult female grizzly bears were transplanted to the area from southeast British Columbia as part of that test. Two criteria were identified as measures of success: bears must remain in the target area for one year, and bears should ultimately breed with native male grizzly bears and reproduce. Reproductive success of any of the remaining individuals could not be established until 2005 when genetic analysis of hair snag samples collected from 2002-2005 indicated that one of the transplanted bears remained in the Cabinet Mountains and had reproduced. Success of the grizzly bear augmentation test prompted continuation of this effort. The Northern Continental Divide Ecosystem area of north central Montana has been the source of an additional 10 female and 8 male bears transplanted to the Cabinet Mountains during 2005-19. Genetic analysis has determined that two females and one male have produced at least 14 first generation offspring, 19 second generation offspring and 3 third generation offspring. Seven bears are known to have left the target area but two have returned. Six augmentation bears are known dead. Fates and movements of these bears are discussed. The augmentation effort appears to be the principal reason that grizzly bears remain in the Cabinet Mountains today.

FORTY-FIVE YEARS OF YELLOWSTONE GRIZZLY BEAR RECOVERY: RESILIENCE OF AN ICONIC POPULATION

Frank T. van Manen[1], Mark A. Haroldson[1], Daniel Bjornlie[2], Justin Clapp[2], Hilary Cooley[3], Cecily Costello[4], Michael Ebinger[1], Kevin Frey[4], Jennifer Fortin-Noreus[3], Kerry Gunther[5], David Gustine[5], Pat Hnilicka[3], Curtis Hendricks[6], Jeremy Nicholson[6], Daniel Thompson[2], Daniel Tyers[7], and Katharine Wilmot[5]

[1] *U.S. Geological Survey*
[2] *Wyoming Game and Fish Department*
[3] *U.S. Fish & Wildlife Service*
[4] *Montana Fish, Wildlife and Parks*
[5] *National Park Service*
[6] *Idaho Department of Fish and Game*
[7] *U.S. Forest Service*

The path to recovery of the Yellowstone grizzly bear (Ursus arctos) population started 50 years ago, at a controversial intersection of science, policy, and public opinion. The concerted and visionary conservation efforts that followed reversed the declining population trends of the late 1970s. By addressing causes responsible for mortality, the population exhibited 4.2 to 7.6% annual growth from the mid-1980s to late 1990s. Evidence suggest the rate of population growth slowed in the early 2000s primarily in the Yellowstone Park and the Recovery Zone, with density-dependent factors playing a role. However, range expansion and growth have continued and now provide realistic prospects of genetic connectivity of this isolated population with other ecosystems. Using long-term data collected by the Interagency Grizzly Bear Study Team (IGBST), we explore the genetic status of grizzly bears in the Greater Yellowstone Ecosystem, and assess the potential for genetic linkage with other populations. We also explore the other side of this conservation success, with grizzly bears expanding their range into areas with greater human footprints and different landscape contexts compared with the core Recovery Zone. Bear managers face mounting challenges associated with human-bear conflicts, requiring a careful balance of conservation objectives, socioeconomic factors, and human safety. We provide detailed insights into the demography of recovery and processes driving continued range expansion and concurrent changes in patterns of human-bear conflict. Furthermore, we assess factors contributing to the resilience of this population despite substantial ecosystem changes in recent decades associated with environmental and anthropogenic factors.

INCORPORATING HUMAN ATTITUDES AND PUBLIC INVOLVEMENT INTO GRIZZLY BEAR MANAGEMENT IN MONTANA

Cecily Costello[1], Justin Gude[1], Michael Lewis[1], Alexander Metcalf[2], Elizabeth Metcalf[2], Holly Nesbitt[2], Lori Roberts[1]

[1] *Montana Fish, Wildlife & Parks*
[2] *University of Montana*

Some federally threatened grizzly bear (Ursus arctos) populations in the lower 48 U.S. states have achieved recovery goals are being considered for delisting. Their spatial distributions have also expanded beyond designated recovery zones that are predominantly public lands to include more human-dominated landscapes with substantial private ownership. The increasing presence of bears in these areas between recovery zones improves the likelihood of achieving desired connectivity among the now-isolated populations, but potentially weakens public support for grizzly bear recovery because of perceived and/or actual increases in bear-human conflict. I present an overview of two recent efforts designed to understand human attitudes toward grizzly bears in Montana and involve the public in development of grizzly bear management strategies within the state. The first project was a survey mailed to 5000 randomly selected households throughout the state. This anonymous, geotagged survey was designed to: assess general knowledge about grizzly bears among the public; understand the breadth of attitudes about grizzly bears and their management; evaluate the influence of geography and livelihood on attitudes; and appraise support for expansion of populations. The second project involved soliciting recommendations from an 18-member Grizzly Bear Advisory Council selected by the Governor to represent a cross-section of Montanans, including agricultural producers, conservationists, wildlife enthusiasts, outdoor users, and other interested citizens. Council recommendations were developed over 10 months with near-monthly public meetings held in different regions of the state. These efforts provided valuable data and understanding about the diversity of values and attitudes among the public regarding grizzly bears in Montana. The improved understanding of the drivers of human attitudes may offer opportunities for reaching common ground regarding future grizzly bear management in Montana and elsewhere.

CONSERVING CONNECTIVITY THROUGH ECOLOGICAL NETWORKS AND CORRIDORS

Gary Tabor

Global habitat fragmentation continues to rise unabated. Add rapid climate change into the equation and the output begins to show that the planet's resilient capacity to respond to large-scale human and natural disturbances is being undermined. Protected area conservation strategies remain the cornerstone of saving nature, yet many protected areas exist as ecological fragments in a matrix of incompatible land and marine uses. Connectivity conservation is an emergent conservation practice that complements and expands the ecological functionality of protected areas. Large carnivore research has been at the forefront of connectivity conservation but only recently has the science become more mainstream. In fact, since 2002, the world has witnessed an exponential increase in the development and implementation of ecological connectivity conservation plans. Yet, there is no consistent practice or implementation standards to guide this emergent energy. The World Commission on Protected Areas through its Connectivity Conservation Specialist Group has recently developed a draft global guidance for ecological corridors and large scale ecological networks. This presentation will highlight trends in connectivity conservation from global and regional perspectives. In addition, the presentation will share recommendations on what actions contribute to successfully implemented connectivity conservation plans.

CONNECTIVITY CONSERVATION OF THE WORLD'S 8 BEAR SPECIES: AN OVERVIEW

Michael F. Proctor[1], Bruce N. McLellan[2], Canada, Trisha Dutta[3], Shaenandhoa Garcia Rangel[4], Dave Paetkau[5], Ron Swaisgood[6], Andreas Zedrosser[7]

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[2] BC Ministry of Forests, Lands & Natural Resource Operations
[3] University of Goettingen, Germany
[4] UN Environment World Conservation Monitoring Program, UK,
[5] Wildlife Genetics International, Canada
[6] San Diego Zoo, USA
[7] University of Southeast Norway

Bears are increasingly beleaguered by population fragmentation globally and there is a need to understand and manage bears for connectivity for their long-term survival. Our ability to manage the resulting assemblages of populations for demographic interchange to resist declines and range contraction defines a new arena of conservation. Here we provide an overview of our understanding of population fragmentation of all 8 bear species and provide a synthesis of the science and lessons learned that might be applicable to lesser understood systems. We start with the circumpolar naturally fragmented polar bear distribution that has been thoroughly delineated using genetics, touching on its relationship to larger threats from climate change. Brown bears across the globe are secure as a species, but their southern distribution in 3 continents is a fractured disarray of sub-populations requiring connectivity management where feasible. We look at methods and management actions underway in North America and Europe and emerging connectivity science across Asia. Sloth bears in India are severely fragmented into anthropogenic populations, with genetic data being used to delineate subpopulations and levels of connectivity to inspire management. Genetic monitoring within the greatly contracted giant panda range shows that this species has degraded into a set of subpopulations and connectivity management is becoming a new reality. For the Andean bear and the forest-reliant sun bear, fragmentation research relies on proxy data such as habitat and forest loss which provides an initial but incomplete picture of their state of fragmentation. Whether or not these systems can function with enhanced inter-population connectivity, or slowly continue with more intense fragmentation, will likely depend on our ability to manage them appropriately. This talk is designed to set the stage for the Connectivity Session that will provide in depth papers on most species.

POPULATION FRAGMENTATION THREATENS THE RECOVERY OF THE GIANT PANDA

Ronald Swaisgood

San Diego Zoo

Population fragmentation is one of the leading factors threatening the persistence and recovery of giant pandas (Ailuropoda melanoleuca) and re-establishing connectivity figures prominently in conservation planning and practice for the species. The panda's distribution was once widespread, covering large areas of China and Southeast Asia, but the current population of fewer than 2,000 adult individuals resides in 33 subpopulations characterized by varying degrees of isolation, fragmented by roads, agriculture and human infrastructure development. Range occupancy in the species is well documented via circa decadal surveys conducted throughout the panda's range by the Chinese government, and these data are complemented with large-scale efforts to understand genetic connectivity using fecal DNA surveys. I will review the current state of panda habitat and genetic connectivity as discerned by these and other sources, summarize past and ongoing efforts to establish an effective protected area system for pandas, and suggest additional measures that should be taken, such as corridor construction and translocations. Recently downlisted from Endangered to Vulnerable by the International Union for the Conservation of Nature, the giant panda requires additional conservation action to ensure its recovery is not jeopardized. Mitigating historical actions that have created high levels of fragmentation will be required to keep the panda on the path to recovery.

COMPARING CONNECTIVITY AMONG SLOTH BEAR POPULATIONS FROM TWO LANDSCAPES IN INDIA

Prachi Thatte[1], Nidhi Yadav[1], Anuradha Chandramouli[1], Uma Ramakrishnan[1]

[1] *National Centre for Biological Sciences*

Once common throughout the Indian subcontinent, the Sloth bear is now restricted in its geographic distribution and is classified as vulnerable by IUCN. The primary threat to the survival of sloth bears is habitat loss and fragmentation. The loss of connectivity resulting in isolation of fragments can lead to reduced genetic diversity and increased extinction risk. We wanted to investigate connectivity among sloth bear populations in India. We carried out replicate studies in two landscapes- central Indian landscape and southern Aravallis landscape. We used non-invasively collected scat samples as a source of DNA and individually identified sloth bears using a panel of 12 microsatellite loci. Genotyping error and PID (1.6 x 10-7) was low. Results revealed lower genetic differentiation among populations in the central Indian landscape compared to southern Aravallis. This could be attributed to the wide distribution and possibly higher effective population size in central India. Landscape genetic analysis (based on data from central India; southern Aravallis data is being analysed) revealed low impact of landscape features including roads and agriculture on sloth bear connectivity, although the model fit was poor (marginal R2- 0.034). Our results highlight the need to combine different data sources and develop methods complementary to landscape genetics to understand the impact of landscape features on species with low genetic differentiation. We found several sloth bear samples outside protected areas in both the landscapes that are likely to contribute to the connectivity and low genetic differentiation. Conservation in India tends to focus on large mammals in protected areas. While this is important, it may not be an effective conservation strategy for widely distributed and genetically well-connected populations of species like the sloth bear. For such species, conservation value of non-protected areas and small habitat fragments might be high despite being embedded in a human dominated landscape.

AN OBJECTIVE APPROACH TO IDENTIFYING UMBRELLA SPECIES FOR LARGE MAMMAL CONNECTIVITY CONSERVATION IN EUROPE

Trishna Dutta[1], Marta De Barba[2], Johannes Signer[1], Shane Frank[3], Ancuta Fedorca[4], Alberto García-Rodríguez[5], Jennifer Hansen[3], Wilfried Thuiller[2], Pablo Lucas[5], Luigi Maiorano[6], Femke Pflüger[1], Nuria Selva[5], Andreas Zedrosser[3], Niko Balkenhol[1]

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The viability of many species depends on the potential of successful dispersal between populations across landscapes. This is particularly true for terrestrial large mammals, many of which are sensitive to the impacts of habitat fragmentation. Climate and land-use changes further necessitate proactive management and protection of areas that facilitate animal dispersal and wide-ranging movements. Promoting connectivity is therefore one of the most widely-applied conservation measures. It is, however, challenging to implement effectively as it requires a large scale understanding and the identification of movement corridors potentially used by multiple species.

We simulated corridors for 24 large mammals between IUCN category I-IV protected areas and Natura sites with reported species presence in Europe across 13 broad ecoregions and 38 subregions within continental Europe. We devised a simple approach to quantify and identify which species contribute the most towards pre-identified connectivity goals, and how many species are necessary to fully meet these goals.

Irrespective of the connectivity goal, region, or geographical scale, more than a single species was necessary to meet connectivity goals. The brown bear Ursus arctos was ranked as the best candidate for an umbrella species in the Carpathian region, within the top 5 ranked species in three other broad ecoregions (temperate broadleaf forests in the Iberian peninsula, and temperate conifer forests and boreal forests in the Scandenavian peninsula), and also in 7 subregions (Dinaric mountain mixed forest, Pannonian mixed forest, Rodope montane mixed forest, Eastern Europe forest steppe, Balkan mixed forest, Pyrenees conifer and mixed forests, and Cantabrian mixed forest). Obtaining empirical data on multiple species to understand their performance as umbrella species for connectivity conservation in the region is often difficult. Simulation studies can help in such situations, and assist in a more objective and flexible selection of umbrella species for connectivity conservation. We present these results in context of the brown bear population in Europe, and its role as a focal species for connectivity conservation.

LARGE-SCALE, TRANS-BOUNDARY, CROSS-POPULATION COLLABORATIVE EFFORT FOR BROWN BEAR CONNECTIVITY CONSERVATION IN EUROPE

Marta De Barba[1], Shane Frank[2], Niko Balkenhol[3], Trishna Dutta[3], Ancuta Fedorca[4], Alberto García-Rodríguez[5], Jennifer Hansen[2], Pablo Lucas[5], Luigi Maiorano[6], Femke Pflüger[3], Julien Renaud[1], Nuria Selva[5], Wilfried Thuiller[1], Andreas Zedrosser[2]

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[6] *Department of Biology and Biotechnologies "Charles Darwin", University of Rome "La Sapienza", Italy*

Brown bears in Europe are clustered in 10 populations distributed over a mosaic of landscapes shaped by human presence and activity. Habitat loss, fragmentation, and conflicts with humans are major threats for the species in Europe. Protection of bear habitat and enhancement of connectivity within and between populations have been recommended as actions of highest priority from which the greatest benefits are expected for bear conservation and coexistence with humans across Europe. Local and regional studies to evaluate population fragmentation and efforts to re-establish connectivity and support population expansion are currently being carried out in all European populations. However, effective connectivity conservation could significantly benefit from a broader approach transcending administrative fragmentation across the European landscape and providing a unifying perspective, also in respect to the heterogeneity of data collection and analytical methods employed.

Here we describe the collaborative effort initiated as part of the project Bear Connect to work on connectivity across the 10 brown bear populations in Europe. We involved >30 groups working on bears in >20 countries, representing several contributing institutions/organizations that shared empirical occurrence, telemetry and genotype data on a centralized database. Data gathering and integration was a long and engaged process requiring extensive communication, exchange, and coordination with all the bear research groups over the past two years. To our knowledge, this is the first effort to combine and consolidate this kind of data at a continental scale to work on connectivity for the species. We report about the challenges encountered in implementing such an initiative and to work with the collective data, and call for increased coordination among the brown bear conservation community in Europe. We highlight the benefits of working large-scale, trans-boundary, and cross-population for enhancing understanding of brown bear ecology and connectivity, and ultimately on-the-ground conservation in Europe.

HISTORY, RESTORATION AND MANAGEMENT OF BLACK BEAR: EXAMPLES AND CONSIDERATIONS FOR THE FUTURE.

Laura Conlee

Missouri Department of Conservation

Black bears (Ursus americanus) were once widely distributed throughout forested areas of the United States but were extirpated from large portions of their range by the early 1900s due to overexploitation and habitat loss. Through sound conservation efforts and management of bear populations and habitat, bear numbers have rebounded in many areas and bears now occur over 45-60% of their historical range in the US (Scheick and McCown 2014). Modern day black bear management is one of the great conservation success stories which can be seen throughout much of the US and Canada. We will review the history of black bear management in the US and Canada and discuss how management, conservation, and research has led to the success of this large carnivore throughout much of its historical range. Additionally, we will discuss how management and conservation needs have changed over the years and will continue to evolve in the future.

INDIVIDUAL- AND POPULATION-LEVEL FITNESS CONSEQUENCES ASSOCIATED WITH BLACK BEAR USE OF RESIDENTIAL DEVELOPMENT

Stewart Breck[1], Heather Johnson[2], David Lewis[3]

[1] USDA-National Wildlife Research Center
[2] USGS-Alaska Science Center
[3] Colorado Parks and Wildlife

Bears are negotiating increasingly developed landscapes, but little is known about how such behavioral plasticity influences their demographic rates and population trends. To understand how plasticity in black bear (Ursus americanus) use of residential development influences their population dynamics, we conducted a 6 year study near Durango, Colorado, USA. Using space-use data on individual bears, we examined the influence of use of residential development on annual measures of bear body fat, cub productivity, cub survival and adult female survival, after accounting for variation in natural food availability and individual attributes (i.e., age). We then used our field-based vital rate estimates to parameterize a matrix model that simulated asymptotic population growth for bears using residential development to different degrees. We found that bear use of residential development was highly variable within and across years, with bears increasing their foraging within development when natural foods were scarce. Increased bear use of development was associated with increased body fat and cub productivity, but reduced cub and adult survival. When these effects were simultaneously incorporated into a matrix model we found that the population was projected to decline as their use of development increased, given that the costs of reduced survival outweighed the benefits of enhanced productivity. Our results provide a mechanistic understanding of how black bear use of residential development exerts opposing effects on different bear fitness traits and negative effect on population growth, with the magnitude of those effects mediated by variation in environmental conditions. They also highlight the importance of monitoring bear population dynamics, particularly as shifts in bear behavior are likely to drive increases in human-bear conflicts and the perception of growing bear populations. Finally, our work emphasizes the need to consider the demographic viability of bear populations when promoting the coexistence of people and black bears on shared landscapes.

PREY OR COMPETITOR? EXPLORING THE INFLUENCE OF CATTLE RANCHING ON ANDEAN BEAR OCCURRENCE

Carmen Julia Quiroga Pacheco[1], *Ximena Velez-Liendo*[2], *Andreas Zedrosser*[3]

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Cattle-based livelihoods are globally recognized to be ecologically destructive and related to deforestation, habitat loss, and linked to human-wildlife conflicts. According to the literature, the turn to cattle-based livelihoods from crop-based agriculture has increased cattle-bear encounters, which commonly results in retaliatory killing of bears. In order to determine the effects of cattle ranching on the potential distribution of Andean bears, we used occupancy modelling to describe bear-cattle co-occurrence patterns in one of the least studied ecosystems, the Inter-Andean dry forests of central and southern Bolivia. We used a dataset containing photographs from 106 remote camera stations (7,490 camera nights). The study area contains sites with different conservation protection levels, i.e. two national parks, a municipal protected area, and private lands. Cattel grazing is restricted in national parks and uncontrolled in private lands. We considered protection level as additional variable to determine cattle influence on bear potential distribution.
Overall, we determined a naïve occupancy of 15.46% for Andean bears in the study area. Detection probability of Andean bears was negatively affected by cattle presence, suggesting that bears avoid areas used for cattle ranching. Probability of bear occupancy was negatively related to the protection level, challenging the role of protected areas in Bolivia and their control of cattle ranching activities. Finally, this study suggests that cattle ranching and poor enforcement of land protection status have a negative effect on Andean bear probability of occurrence, and as seen in other similar scenarios, could consequently reduce the number of bears in the area through retaliatory killing of bears. Therefore, cattle ranching is a direct threat to bear conservation that requires urgent attention in future conservation efforts, because it reduces the habitat quality and negatively affects populations through retaliatory killing.

HUMAN–BEAR CONFLICT IN NORTH AMERICA: 1880–2019

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We present an analysis of human–bear (Ursus spp.) conflicts that occurred in North America from 1880 to 2019. We collected 1,682 human–bear conflicts, consisting of 124,226 individual data entries, from the various sources available to us. We found that human–bear attacks are rare events, averaging 2.6/year across the study period, though increasing to 7.6/year in the current decade. Grizzly bears (U. arctos) dominated conflicts (88%), followed by black bears (U. americanus; 11%), and lastly polar bears (U. maritimus; 1%). Although grizzly bear family groups are often involved in conflicts (32% of all attacks), single grizzlies are involved more than any other cohort (45%). Human–bear conflicts occurred during every month of the year and the majority occurred during daytime when people were most active (82%). Human group size was a significant factor in bear conflicts: the larger the group (≥2 persons), the less likely to be involved in a confrontation. Habitat visibility also contributed to conflict, the poorer the visibility the more likely bears were to engage with people, presumably because of an inability to detect them until very close. When domestic dogs intervened in attacks, they terminated them nearly half of the time (47.5%). However, in 12.5% of cases, dogs appeared to have initiated the conflict. When involved, rescuers terminated maulings in 90.3% of cases, but were themselves mauled 9.7% of the time. We offer these, and other, insights derived from this work that will inform wildlife biologists' bear safety training and public outreach.

EFFECTS OF CUMULATED OUTDOOR ACTIVITY ON BROWN BEAR (URSUS ARCTOS) HABITAT USE: A CASE STUDY IN THE CENTRAL ITALIAN ALPS

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We present an analysis of human–bear (Ursus spp.) conflicts that occurred in North America from 1880 to 2019. We collected 1,682 human–bear conflicts, consisting of 124,226 individual data entries, from the various sources available to us. We found that human–bear attacks are rare events, averaging 2.6/year across the study period, though increasing to 7.6/year in the current decade. Grizzly bears (U. arctos) dominated conflicts (88%), followed by black bears (U. americanus; 11%), and lastly polar bears (U. maritimus; 1%). Although grizzly bear family groups are often involved in conflicts (32% of all attacks), single grizzlies are involved more than any other cohort (45%). Human–bear conflicts occurred during every month of the year and the majority occurred during daytime when people were most active (82%). Human group size was a significant factor in bear conflicts: the larger the group (≥2 persons), the less likely to be involved in a confrontation. Habitat visibility also contributed to conflict, the poorer the visibility the more likely bears were to engage with people, presumably because of an inability to detect them until very close. When domestic dogs intervened in attacks, they terminated them nearly half of the time (47.5%). However, in 12.5% of cases, dogs appeared to have initiated the conflict. When involved, rescuers terminated maulings in 90.3% of cases, but were themselves mauled 9.7% of the time. We offer these, and other, insights derived from this work that will inform wildlife biologists' bear safety training and public outreach.

CARNIVORES AND COMMUNITIES: A CASE STUDY OF HUMAN-CARNIVORE CONFLICT MITIGATION IN SOUTHWESTERN ALBERTA

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Facilitating long-term coexistence between people and large carnivores is a persistent conservation challenge. Evidence-based decisions to help design and implement programs that promote coexistence between people and carnivores are required. Using a case study approach, we evaluated the effectiveness of conflict mitigation efforts of a community-based program in southwestern Alberta, Canada: the Waterton Biosphere Reserve's Carnivores and Communities Program (CACP). The CACP's overall goal is to support coexistence of people and large carnivores through initiatives including reducing livestock loss, damage to stored crops, and safety risks from carnivores by engaging residents in hands-on programming. We used an online survey to assess program participants' general awareness of and motivation to engage in the CACP, safety risks associated with living with large carnivores, and attractant management and deadstock removal programming. We received 116 completed surveys. Survey results indicated that participants felt the CACP effectively reduced conflicts with large carnivores, increased their sense of safety when living with large carnivores, and enabled them to learn skills and gain confidence in using mitigation tools (e.g., bear spray). We also evaluated temporal trends in large carnivore conflicts using occurrence records (i.e., complaint data) from 1999 through 2016. We classified these data into incidents (e.g., situations where carnivores caused property damage, obtained anthropogenic food, killed or attempted to kill livestock or pets) and focused on incidents related to attractants, including deadstock. We focus our incident review on grizzly bears because most agricultural attractant incidents in the study area are caused by grizzly bears. We used a Chow test to evaluate if the 2009 CACP commencement represented a break point in the data. We show both reported attractant and deadstock-based incidents changed from increasing to decreasing after the CACP implementation in 2009. Our results demonstrate the effectiveness of a contextually specific, community-based approach to addressing human-carnivore conflicts.

TEMPORAL INTERACTIONS AMONG ANDEAN BEARS, PUMA, AND HUMANS IN SE PERU

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One threat to the Andean bear (Tremarctos ornatus) is the retaliatory killing of bears by people suffering economic damages to bears through crop raiding or livestock loss. One potential way to reduce retaliatory killing and improve local support for bear conservation is ecotourism focusing on Andean bears. However, even low-impact human presence can affect the spatiotemporal distribution of other bear species. Unfortunately, we do not know how Andean bears respond to human presence, even in low-risk contexts. To evaluate whether Andean bears change their behavior in response to low-risk human presence, we are examining the latency to detection of bears, after humans passed in front of trail cameras. We assume that long latencies are biologically irrelevant, so we are ignoring latencies >7 days. For reference, to evaluate whether large mammals all respond similarly to humans, we are also assessing similar latencies to detection of 5 other species >15kg in mass: Mazama americana (red brocket deer), M. chunyi (dwarf brocket deer), Panthera onca (jaguar), Puma concolor (puma), and Tapirus terrestris (lowland tapir). To date, we have analyzed data from 2 years of continual deployment of cameras at sites from 532-3,752 masl in Manu National Park and its buffer zone in SE Peru, where there is little human impact. We have detected >16 individual bears, from 1,558 to 3,586 masl. Of the 6 large mammal species, only the bear shows any temporal response to the passage of humans, with greater latencies to detection of a bear after a human than vice versa. This is surprising, given than bears sometimes approach areas of human activity to raid crops and hunt cattle. We continue to collect data and add analyses to clarify the temporal interactions of bears, large mammals, and humans in SE Peru.

FACTORS AFFECTING HUMAN ATTITUDES TOWARDS ANDEAN BEAR CONFLICT

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The Andean bear is a Vulnerable species that is thought to be threatened mainly by retaliatory illegal hunting (related to human-bear conflicts) and habitat loss. However, no research has focused on understanding factors that lead to the killing of Andean bears, which is a critical link to their conservation. We used diverse and novel methods to analyze 1500 surveys of local farmers in Colombia and Peru, to better understand factors affecting retaliatory killing and attitudes of local people, as well as factors affecting the probability of damage (mainly cattle depredations) caused by Andean bears. We found that attitudes are affected by having had previous damage, the economic context, social and formal norms, the location, opinions about husbandry practices (eg. use of fences), overall trust in governmental organizations, and fear of future bear damage. The likelihood of damage was affected by the area of Andean bear habitat in proximity to where cattle grazed, the cattle raising system (free-ranging or fenced and brought at night), distance from cattle to inhabited houses, frequency that farmers checked their pasture, number of persons living on the land, and handling of attractants (e.g., carcasses). We used logistical and occupancy models to predict depredations caused by Andean bears, and probabilities of retaliatory or preventive killing. These results can serve to formulate site-specific management actions in accord with the local context.

BLACK BEAR MOVEMENTS AND FOOD CONDITIONING ALONG THE URBAN-WILDLAND INTERFACE AT GREAT SMOKY MOUNTAINS NATIONAL PARK, USA

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Conflicts between humans and wildlife have become increasingly important challenges for resource managers along the urban-wildland interface. Food conditioning of American black bears (Ursus americanus) is related to conflict behavior and often occurs in communities adjacent to Great Smoky Mountains National Park (GRSM or Park), USA. The aim of our study was to evaluate black bear space use in GRSM and in exurban areas on surrounding private lands and identify factors associated with food conditioning and conflict behavior. We radiocollared 53 bears (29 males, 24 females) from 2015 to 2017 to compare space use characteristics and used carbon isotopic signatures (δ13C) from bear hair to assess food conditioning. We then performed an integrated step selection function (iSSF) analysis to characterize and compare movement and resource use as related to food conditioning. Annual 95% and 50% Kernel Density Estimate (KDE) home ranges of female and male bears did not differ by level of food conditioning (i.e., mean δ13C), but home ranges of FC females were smaller than NFC females when data from 2015, a year of food scarcity and abnormally large home ranges, were excluded. The mean proportion of exurban development (e.g., roads, buildings, openings) within 95% KDE and 50% KDE home ranges of females increased with mean δ13C ($P < 0.001$) and the same relationship approached statistical significance for males ($P = 0.075$ and $P = 0.057$, respectively). The iSSF models indicated that food-conditioned bears were more likely to use forest openings associated with higher levels of development than non-food-conditioned bears. We used those models to demonstrate how landscape modifications might be used to reduce bear use of urban areas, particularly for NFC bears. Our stable isotope, movement, and resource use data indicate that conflict behaviors displayed by many bears within GRSM were likely learned in areas outside Park boundaries.

ENVIRONMENTAL INFLUENCES ON THE EFFICACY OF BEAR SPRAY

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Several studies have highlighted the effectiveness of bear spray in protecting users from bear attacks. However, failures have also been reported along with speculation regarding the influences of temperature, wind and canister age on spray efficacy. To determine the influence of temperature, wind and age on bear spray, we designed lab experiments. To determine the influence of temperature on spray performance we documented canister head pressures at temperatures ranging from -30 deg C to + 30 deg C and found a strong positive linear relationship. Importantly, even at - 30 deg C, sprays had a range > 4 m, though the plume was not well aerosolized. Using computational fluid dynamics modeling, we simulated the effects of headwinds, crosswinds, and tailwinds on spray performance. We found that even under high (> 10 m/s) headwind and crosswind scenarios, sprays reached targets that were > 2 m directly in front of the user. Not surprisingly, tailwinds boosted spray distance beyond calm air scenarios. By weighing unused canisters of various ages (18 years old to present), we found that brands tested lost weight ranging from 0.65 to 1.92 g/year , presumably due to propellant that escaped canister seals. We discuss these findings in the context of bear safety implications as well as commonly cited reasons for not using this effective deterrent.

TEMPERATURE DRIVES ACTIVE PATTERN AND HABITAT SELECTION OF ASIAN BLACK BEAR

Kahoko Tochigi[1], Sam Steyaert[2], Tadashi Iwasaki[1], Koji Yamazaki[1], Shinsuke Koike[1]

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"Global warming influences movement, reproduction and survival of many kinds of animal species. Mammal have a function to regulate body temperature and keep it in proper range from dynamic temperature change in outside of their body, some mammal species move resting site to high altitude and move under low temperature vegetation as thermal shelter in reaction to increase of temperature. However, those habitat is not selected usually, thus is possibly not suitable for habitat because of low availability of food resource. But whether mammal actually foraged in the selected habitat is unknown.
The goal of our study is to investigate change of activity pattern according to temperature in habitat selected by avoiding heat stress. We chose Asian black bear (Ursus thibetanus) as a target species, subject to heat stress because of large body size. We hypothesized (1) Bears would not select low temperature habitat in relatively cool season like spring and autumn. (2) Bears would select habitat with low temperature in summer by avoiding heat stress. (3) Bears would feed in substitute habitat at high temperature but under the condition of low temperature, bears feed in the high food availability habitat with high temperature. We used location data for 17 bears captured from 2006 to 2012. We classified the activity patterns and habitat types in each location, applied conditional logistic model (1 and 2) and multinomial logistic model (3). Bears habitat selection is not effected by temperature in spring and autumn, but bears avoided hotter habitat in summer. Additionally, under high temperature, bears feed in cooler habitat that is not habitat with the highest food availability. Habitat selection due to avoiding heat happens more frequently by advance of global warming, the gap between demand and food resource amount bears actually get may become bigger, leading to bad nutritional condition."

HUMAN INJURIES AND FATALITIES BY BROWN BEARS IN RUSSIA REVEAL A LINK BETWEEN HABITAT DEGRADATION AND HUMAN-WILDLIFE CONFLICT

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Threat to human safety is the most dramatic expression of conflict between large carnivores and humans (1-3). Brown bears are one of the most involved species in attacks to humans in North America and Eurasia (4,5). Frequency and severity of bear attacks vary globally and are associated with bear population increase (6), human encroachments into areas rarely visited before (7), and human disregard to safety rules in bear country (8). Human negligent behaviour and unproper management of bear attractants lead to bear-food conditioning and habituation (4,9), which results in human injuries and deaths as well as in removal of problem bears (7,10). However, brown bear attacks´ reporting and their scientific investigation are hardly associated with bear population numbers and remain poorly studied in Russia (6), where at least half of the world´s brown bears live (11). Here we show that increasing brown bear incidents in Russia are linked with the species population increase, the magnitude of habitat degradation due to augmenting road density and with the presence of Siberian pine. Growing bear population alone seemed to contribute to more frequent attacks only in European Russia. In Asian Russia, however, recurring attacks were associated with increasing road density and the presence of Siberian pine, a crucial food source for bears in the pre-denning period. Our results reveal a link between habitat fragmentation (road construction), food availability, and bear attacks on humans. Inefficient attention is currently given to habitat changes in Russian forests despite their wide repercussions for boreal forest wildlife and ecosystem functioning at various spatial levels. Intensifying human-bear conflict may imperil bear conservation, posing yet another threat for wildlife facing illegal trafficking of body parts (12,13) and habitat destruction (14) in one of the very scarce areas of the world still inhabited by several species of large carnivores (15).

BROWN BEAR-HUMAN ENCOUNTERS IN IRAN RESULTING IN INJURY OR DEATH

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Brown bear-human interactions occur wherever these species occur in sympatry and in extreme cases, can result in injury or death to bears or humans. Brown bears (Ursus arctos) occur primarily in the Zagros Mountains of western Iran and the Alborz Mountains of northern Iran. We compiled data on brown bear-human interactions in Iran from 2005 to 2019 using material published and disseminated by the Iranian government. Of 119 reported human-caused mortalities of brown bears, 68% were illegally shot (64 bears were shot by poachers and 17 bears by local people), 18% died from collisions with vehicles, 9% were stoned, and remaining bears were trapped (2%), killed by trains (2%), or poisoned (1%). Of these, 3 bears were killed in defense of humans for their lives, and 20 bears were killed in defense of agricultural crops or livestock, with sheep representing 62% of livestock depredations. Twenty-three percent of bears killed by humans were female, 22% were male, and 55% were unspecified. Also, 36% of bears killed by humans were adults, 11% were juveniles, 27% were cubs-of-the-year, and 26% were of unspecified age. Bears attacked 57 humans, injuring 91% and killing 9%. Shepherds were attacked most (46%) by bears. We suggest Iran's Department of the Environment (the responsible governmental organization) consider the following to mitigate bear-human conflicts: 1) increase the number of wardens within protected areas to reduce the number of brown bears illegally shot, 2) educate local people and communities to promote brown bear-human coexistence, and 3) encourage shepherds to use alternative animal husbandry systems (e.g., night penning) instead of traditional practices (e.g., free-range grazing) to reduce brown bear attacks.

ESTIMATING THE SEASONAL ENERGY BALANCE IN ASIAN BLACK BEARS AND ASSOCIATED FACTORS

Shinsuke Koike[1], Shino Furusaka[1], Kahoko Tochigi[1], Koji Yamazaki[1], Tomoko Naganuma[1], Akino Inagaki[1]

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Energy balance is an essential factor when evaluating an animal's nutritional state. We aimed to identify periods of the year that are most important for Asian black bears (Ursus thibetanus) in terms of energy balance. We estimated bears' daily energy balance by estimating energy intake based on the energy content (kcal/g) of major food items, their average ingestion rate (g/min), and daily feeding time (min) and estimating energy expenditure using an equation for the costs of resting, traveling, and feeding based on behavioral data of 34 bears fitted with GPS collars in central Japan. We identified major food items from fecal analysis and calculated the gross energy content per unit for each item. Based on direct observation of bears feeding over 10 years, we measured ingestion rates of the major food items; Quercus crispula acorns on the tree had the highest ingestion rate, whereas the values of other items did not show notable characteristics. The variability of energy expenditure rose moderately in good mast years, except for males. On the other hand, there was a bimodal pattern of energy intake and energy balance, declining from May to July, rising again from August to October, and declining in November. The peak of energy intake and energy balance was larger in good mast years than in poor mast years only for females, whereas the cumulative energy balance in good mast years was larger than in poor mast years for both sexes. After poor mast years, the cumulative energy balance of males become negative in February, during hibernation, and did not exceed zero until August, even if they could start feeding in May. Thus, further longitudinal studies that examine cumulative energy balance, rather than energy balance alone, are necessary to clarify the seasonal change in the nutritional state of Asian black bears.

MONITORING SLOTH BEAR MOVEMENT AROUND WATER SOURCES TO ASSESS THE EFFECTIVENESS OF WATER MANAGEMENT IN SLOTH BEAR HABITAT

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Water acts as a limiting factor in the dry deciduous forests of western India especially during summer, perhaps driving sloth bears and other wild animals towards human settlements resulting in conflicts. Eighty percent of sloth bear attacks in the study area have been located close to water sources near villages. Our research focused on reducing the movement of sloth bear towards villages by understanding their water requirements and providing alternatives further from villages. Twenty-four naturally occurring water sources were identified in two protected areas in North Gujarat using hydrological modelling, camera trapping surveys, and sloth bear sign. The survey was carried out before and after monsoon to evaluate bear activity near water sources. The proximity of these water bodies to human settlements was also assessed. Ten remote cameras were deployed in rotation at all the water sources for a minimum of 20 days after monsoon to survey bear activity. We also assessed local food resources to understand the link between food availability near water and found 22 different fruiting species used by bears. Our results reveal that sloth bears visited a majority of water bodies irrespective of food availability indicating water as an important factor in governing bear movements. Interestingly, sloth bears avoided overlap with leopards at water sources. The activity was reduced in pre-monsoon due to less availability of water. Based on our findings, we recommended authorities construct permanent structures to retain water after rainfall. After construction, our monitoring will continue for another year to check the effectiveness of this technique in retaining water for longer duration, use by bears, and local bear-human conflict rates. These water sources can be a novel solution not only for reducing costs of water management, but also alleviating confrontation between humans and sloth bears.

IDENTIFYING HIMALAYAN BROWN BEAR (URSUS ARCTOS ISABELLINUS) CONSERVATION AREAS IN LAHAUL VALLEY, HIMACHAL PRADESH

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Large carnivores that occur in low densities, particularly in the high-altitude areas are globally threatened because of habitat loss and anthropogenic disturbances. In the Indian Himalayan regions, the Himalayan brown bear (HBB) is mostly distributed in the high-altitude ranges but poorly studied due to elusive nature and rugged landscape. Much of its distribution range in India is largely unexplored and hence, no scientific information is available which is vital for the conservation of the species and management of its habitats.
We aimed at assessing the distribution and occupancy of brown bear in the Lahaul Valley of Himachal Pradesh. We have used both sign survey and camera trapping for understanding the site occupancy of the species using habitat covariates. The study landscape was divided into 10 km x 10 km grids, and in each grid, at least 4 camera traps were deployed strategically. Further, a total of 56 trails were also surveyed in the selected grids. The total effort of n=758 camera nights and 544 km trail walk resulted with naïve occupancy of 0.54 in the Lahaul Valley, which is slightly lower than the estimated one (0.562–0.757). Out of 34 single-season occupancy models run for the brown bear with different site co-variants, only ‘agriculture land’ (β = 24; ±14) and combined effect of ‘agriculture land + alpine grassland’ (β= 28.0±10) showed a positive association with occupancy of brown bear in the Lahaul Valley. Whereas, detection probability was mostly explained by habitat covariates such as ‘human settlement’ (β = 0.00 ± 0.00) and ‘alpine grassland’ (β = -0.73, ±0.31) which showed a negative association. The positive relationship of occupancy with agriculture land indicated that HBB are using agriculture land which is leading to increasing bear-human conflict. Through the present study, we identified few areas in Lahaul Valley for priority conservation actions.

IS THERE INTERNAL DEMAND FOR BEAR PARTS IN MYANMAR? AN EXPLORATORY STUDY IN RAKHINE STATE

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Sun bears (Helarctos malayanus) are threatened across Southeast Asia due to demand for their parts, as well as increasing loss of habitat and associated habitat fragmentation. In Myanmar, sun bears are protected; however, prior evidence has shown that they are poached for trade across the border to China. In this study, we explore consumption among Myanmar nationals in Rakhine State, a well-forested region where poaching of sun bears is known to occur. Using quantitative and qualitative approaches, including specialized questioning techniques designed to reduce survey bias, we interviewed 327 individuals in villages throughout Rakhine on their consumption of bear products. We found that individuals in Rakhine rarely use any bear product, although they sometimes consume bear meat. We also found that despite the poaching of bears that occurs in the area, individuals did not believe bear gallbladder/bile was easily accessible. Furthermore, they did not believe that the use of gallbladder/bile was part of their culture. We speculate that these results, and in particular the low level of bear gallbladder/bile use, could possibly be due to two factors. One is the high density of sun bears compared to Asiatic black bears, and a corresponding lack of real medical benefit in the bile of the bears, and/or two, a historic lack of trade between this relatively isolated region and China. To our knowledge, this is the first published example from a bear-resident country in Southeast Asia that does not also have high endemic demand for bear products.

THE STATUS OF HUNTING OF BROWN BEARS IN EUROPE: IS IT GOOD OR BAD FOR BEARS?

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To evaluate the status of hunting of brown bears in Europe, we surveyed members of the European Brown Bear Expert Team, representing 24 countries and 11 bear populations in Europe, including the European part of Russia. Surprisingly, 17 countries have no clear population goal. Bears are hunted in 12 countries (7 populations), but in 4 of these countries there is currently and officially no active hunting (Bulgaria, Montenegro, Slovakia, and Romania). Countries allowing hunting have 600 to 6500 bears, except Norway, with about 138 bears and Russia with more bears than all other countries together. The Alpine, Apennine, Pyrenees and Cantabrian populations are totally protected from hunting and are the smallest and most endangered. Segments of the populations that are large and in favorable conservation status are hunted in some of range countries and fully protected in others. For example, Dinara-Pindos bears are hunted or listed as game in Slovenia, Croatia, Bosnia and Herzegovina, and Montenegro, but not in Serbia, Kosovo, North Macedonia, Albania, or Greece. Carpathian bears are game species in Romania and Slovakia, but not in Poland, Ukraine, or Serbia. Intervention removal (lethal or to captivity) is conducted or perceived as a management tool in 14 countries, ranging from 0-140 bears annually per country (latter number in Romania).

Twelve of those countries have a protocol for removals, but only 9 country experts believe that the removal is selective to the problem individual. About half of the experts believe that removals help to reduce damages (12) and increase public acceptance (15), but only 7 believe that it helps to reach the population goals (if any).
For European Union members, removal of bears must be cleared through derogation of strict protection by the Habitats Directive. Of the 12 countries that hunt bears, 8 are EU members and 4 are not.

ARE BROWN BEAR CONSERVATION PROJECTS AND NATIONAL WILDLIFE POLICY IN ROMANIA AT ODDS?

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The brown bear has been at the epicentre of many European conservation programmes, helping to maintain suitable conservation status for most European populations. Romania represents a test case, with a large brown bear population, and long management history. The communist period was characterized by a centralised wildlife management focused on harvesting trophies. Upon joining the Bern Convention and European Union, the regulatory framework changed, with bears becoming a protected species, but continued focus on regulated hunting. Romanian authorities had no mechanism in place to evaluate the impacts of past wildlife policies on the bear population and habitat. In this context, several conservation projects financed by EU funds and private foundations, implemented since 2002, tackled ecological and social data gaps (e.g., population estimation, habitat management, human-bear coexistence), and proposed best management practices. Nevertheless, the impacts were limited to local scales, due to lack of political support for systemic changes to wildlife administration and legislation. While non-lethal management solutions to alleviate human-bear conflict have been proposed, they have not been implemented due to a rigid legislative and administrative system. Concomitantly, there is increasing pressure to substantially reduce bear abundance, fuelled by a politically charged climate and a campaign focused on negative aspects of wildlife damage. To objectively evaluate the potential contribution of lethal and non-lethal management to promote human-bear coexistence in Romania, we identify several prerequisites: (1) existence of a clear plan for removal of individuals through hunting that is informed by bear ecology, (2) implementation of national scale programs dedicated to reduce conflict, (3) developing a flexible administrative and regulatory wildlife framework, and (4) increasing the capacity to evaluate outcomes of policies via cross-sectoral collaboration. We argue that outcomes of conservation projects and national policy must inform each other to produce positive long-term impacts for both people and bears.

SAVING SUN BEAR – A TWO DECADES OF JOURNEY TO CONSERVE THE LEAST KNOWN BEAR IN SABAH, MALAYSIA BORNEO

Siew Te Wong

Sun bear was the least known bear in the world and still remains the least known bears in the world. Research on sun bear was considered the top priority for bear conservation two decades ago. Siew Te Wong was one of the three researchers who started the ecological study on Bornean sun bear in 1998 and published several scientific papers on them. The studies revealed their illusive life history, and threatened by deforestation, poaching, pets keeping and fruit production failures. In 2008, Wong founded the Bornean Sun Bear Conservation Centre (BSBCC) with the partnership from Sabah Wildlife Department (SWD), Sabah Forestry Department and LEAP in Sandakan, Sabah, Malaysia Borneo. The centre aims to conserve sun bears through holistic approaches that incorporate improve animal welfare, education, research, rehabilitation, community conservation, ecotourism, captive breeding and anti-poaching to address all the conservation challenges face by the sun bears in Sabah. To-date, BSBCC has cared for 61 sun bears that were rescued by SWD across Sabah. The centre was opened to the public in 2014 and conducted series of education programs at the centre and education outreach programs across Sabah. BSBCC also hosted more than a dozen research projects on both captive and wild sun bears by local and foreign researchers. Seven rehabilitated sun bears have been successfully rehabilitated and released back to the wild. Approximately 400,000 visitors visited BSBCC since 2014 from across the world. Since 2014, the operational costs of BSBCC were fully covered by revenues generated from ticketing, merchandise and donations. These revenues also partially covered projects on construction, conservation education, research, rehabilitation, and community conservation. BSBCC is a novel example of conservation project works a long side with ecotourism and incorporates multiple conservation actions to conserve sun bears in Sabah.

AN APPEAL FOR PRECISION WILDLIFE CONSERVATION

Ozgun Emre Can

Oxford Conservation Initiative

There is a need for innovative thinking in the battle for the conservation of wildlife in Asia, Africa, and South America. To alleviate increasing threats to wildlife populations and habitats, conservationists search for ideas and tools that can be transferred to the field of conservation from other academic disciplines. Medicine is one of these disciplines, and the concept of 'evidence-based medicine' has been increasingly mentioned in conservation circles.

In the last two decades, evidence-based medicine became "an energetic intellectual community committed to making clinical practice more scientific and empirically grounded". However, according to some researchers, evidence-based medicine is about having inflexible rules in the form of algorithmic if-then reasoning that is often too simple to guide decision-making needed when curing individual patients. Strong criticisms have been published about this concept in leading medical journals. One editorial states that evidence-based medicine "is not 'evidence-based' because it does not meet its own empirical tests for efficacy."
In this talk, I will first, present what evidence-based medicine is, its benefits and shortcomings in treating individual patients and discuss how the term "evidence-based" is misleading for those involved in wildlife conservation as if the current practice of medicine isn't based on scientific evidence. Next, I will discuss the dangers of adopting an inflexible algorithmic if-then type of mind-set and one-size-fits-all guidelines in wildlife conservation. In conclusion, I will argue the need for 'precision conservation' targeted to individual populations, similar to 'real evidence-based medicine', which puts "care of individual patients as its top priority, asking, "what is the best course of action for this patient, in these circumstances, at this point in their illness or condition?" The bedrock of conservation is evidence; conservation should involve determining what is at stake for individual wildlife populations and implementing the best course of action for their long-term survival.

UNDER THE MIDNIGHT SUN: PERSISTENCE OF CIRCADIAN RHYTHMS IN FREE-RANGING POLAR BEARS.

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Life in the Arctic presents organisms with multiple challenges including extreme photic conditions, cold temperatures, and annual loss and daily movement of sea ice. Polar bears (Ursus maritimus) evolved under these unique conditions where they rely on ice to hunt their main prey, seals. However, very little is known regarding the dynamics of their daily and seasonal activity patterns. For many organisms, activity is synchronized (entrained) to the earth's day/night cycle, in part, via an endogenous (circadian) timekeeping mechanism. The present study utilized collar-mounted accelerometer and GPS data from 122 female polar bears in the Chukchi and Southern Beaufort seas collected over an 8-year period to characterize activity patterns over the calendar year and to determine if circadian rhythms are expressed under the constant conditions found in the Arctic. We reveal that the majority of polar bears (80%) exhibited rhythmic activity for the duration of their recordings. Collectively within the rhythmic bear cohort, circadian rhythms were detected during periods of constant daylight (Jun-Aug; 24.40 ± 1.39h, mean ± SD) and constant darkness (23.89 ± 1.72h). Exclusive of denning periods (Nov-Apr), the time of peak activity remained relatively stable (~1200 – 1400h) for most of the year, suggesting either entrainment or masking. However, activity patterns shifted during the spring feeding and seal pupping season as evidenced by an acrophase inversion to ~2400h in Aprily. Intriguingly, despite the dynamic environmental photoperiodic conditions, unpredictable daily timing of prey availability, and high between-animal variability, the average duration of activity (alpha) remained stable (11.2 ± 2.9h) for most of the year. Together, these results reveal a high degree of behavioral plasticity in polar bears while also retaining circadian rhythmicity. Whether this degree of plasticity will benefit polar bears faced with a loss of sea ice remains to be determined.

POLAR BEAR BODY CONDITION IMPROVES WITH CHANGING SEA ICE CONDITIONS IN THE GULF OF BOOTHIA AND M'CLINTOCK CHANNEL: THE BOOM BEFORE THE BUST?

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Access to sea ice is essential for polar bears to acquire their core prey of seals. Seals prefer various ice types over thicker multi-year pack ice as habitat. Some polar bear subpopulations are situated in areas that historically were covered by poor seal-habitat ice but recently were transformed into more preferable sea ice, mostly through climatic changes. The M'Clintock Channel (MC) and Gulf of Boothia (GB) subpopulations experienced drastic sea ice changes, and long-term impacts are unknown. In order to examine any possible intermediary impacts on polar bears, we compared body condition of bears, of various age and sex classes, collected during the spring season when thick multi-year ice (1998-2000) was common to a period (2014-2017) in which there was more annual, dynamic ice. Body condition of bears was scored within a 1-5 scale where 1 is extremely skinny and 5 extremely obese. Raw scores were further consolidated into 3 categories (poor, average, and good) to increase power and remove any possible bias. Bear body condition improved between the two periods with bears being in better condition during the recent time period. Trends within reproductive groups remained similar across time where adult females with offspring were the most likely to be in poor body condition. In the earlier time period, body condition was affected negatively as the number of days, when the sea ice was below the mean concentration, increased. However, this trend was reversed in the recent period. We hypothesize that changing sea ice conditions over time have influenced the ecosystem such that productivity in these regions is likely increasing through the improvement in seal habitat and primary productivity. Because neither GB nor MC experience completely ice-free periods, the increase in days when sea ice is below mean concentrations may represent short-term positive effects for bear body condition.

SYMPATRIC PREDATORS: THE EFFECT OF BROWN BEARS ON WOLF HUNTING BEHAVIOR

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Interspecific competition between top-predators can either relax or strengthen their cumulative effect on prey populations and subsequent ecosystem function, depending on the nature of their interactions. Bears are typically dominant scavengers of kills made by other predators and are also efficient predators of neonate ungulates. Contrary to previous expectations, recent research suggests that bears may dampen wolf kill-rate where the two species are sympatric. However, the mechanism behind this pattern remains unclear. We utilized long-term datasets from Scandinavia (Europe) and Yellowstone National Park (North America) to describe variation in wolf behavioral patterns in a) areas with and without bears and b) when bears were present or absent from wolf-kill sites. We tested two hypotheses for why wolf-kill interval might be extended in the presence of bears. 1) Interference competition hypothesis: Bears are typically dominant competitors at wolf-kill sites which may cause wolves to either linger at a stolen carcass waiting to gain access to food resources, or stay at their kill site longer in order to defend it from scavengers. This is more likely to occur when wolves kill larger prey (e.g., adult moose or elk) as there is longer time spent at the kill site and more biomass to compete over. 2) Exploitation competition hypothesis: Bears may deplete the supply of a shared prey resource resulting in fewer available prey for wolves and longer search times. This would be expected during summer when both wolves and bears prey heavily on neonate ungulates.

FAMILIARITY TRUMPS FAMILY: THE INFLUENCE OF THE SOCIAL LANDSCAPE ON POST-NATAL SETTLEMENT OF FEMALE BROWN BEARS

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How and where a female selects an area to settle and breed is of central importance in dispersal and population ecology as it governs range expansion and gene flow. Social structure and organization have been shown to influence settlement decisions, but its importance in settlement of large, solitary mammals is unknown.

We investigate how the identity of overlapping conspecifics on the landscape, acquired during the period of maternal care, influences selection of settlement home ranges in a non-territorial, solitary mammal using location data of 56 female brown bears (Ursus arctos). We used a resource selection function to determine whether females' settlement behavior was influenced by presence of their mother, related females, familiar females, and female population density.

We found that females selected settlement home ranges that overlapped their mother's home range, familiar females, i.e. those they had previously overlapped with, and areas with higher density than their natal ranges. However, they did not select areas overlapping related females. Our results suggest that females are acquiring and using information about their social environment when making settlement decisions.

IMPACTS OF RECOLONIZING AMERICAN BLACK BEARS (URSUS AMERICANUS) ON COUGAR (PUMA CONCOLOR) PREDATION BEHAVIOR AND SPACE USE

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In the Great Basin Desert USA, cougars (Puma concolor) have been thriving as the apex predator without competition from other large carnivores for approximately 80 years, due to the extirpation of black bears (Ursus americanus) and grizzly bears (U. arctos) from the region by the 1930s. However, conservation efforts over the past 20-30 years have allowed black bears to begin successfully recolonizing their historic range in the Great Basin. Data from ongoing studies focused on black bear recovery and cougar population demographics throughout the eastern Sierra Nevada and western Great Basin Desert indicate that black bears frequently visit and kleptoparasitize prey resources from cougars. This suggests that there may be differences in bear and cougar interactions across mountain ranges and over time as black bears recolonize the region, but the impacts of bear density and scavenging pressure on cougar foraging behavior have not been fully explored. Here we use the opportunity to explore bear and cougar interactions under situations of natural recolonization by a once extirpated apex carnivore as the Great Basin undergoes a system-wide shift to bears as the apex carnivore once again. Using data from kill site investigations collected from 30 GPS-collared cougars between 2009 and 2017, we will discuss the effects that the recovery and increasing population of recolonizing black bears have on cougar kill rates and prey selection. We used general linear mixed models to determine whether changes in bear density and scavenging pressure at kill sites impact cougar kill rate and prey selection over time across multiple mountain ranges, both with and without recolonizing bears. Understanding to what extent black bears usurp cougar kills will reveal the impact that black bear scavenging has on cougar predation of mule deer, feral horses and other prey and, thus, aid in managing predators and prey. Our efforts combine data from long-term studies of two large carnivores outside protected areas to improve our understanding of predator community dynamics with a recolonizing bear population. Subsequently, our results could inform the development of management and conservation plans for multi-predator, multi-prey systems in working landscapes.

DEMOGRAPHY OF A SMALL ANDEAN BEAR POPULATION IN THE EQUATORIAL DRY FOREST OF NORTHWESTERN PERU

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Population declines of large mammalian carnivores are major concerns for global biodiversity and have become a focus of conservation due to their flagship appeal, ecological role as top predators, and as umbrella species in the conservation of other species. Carnivore conservation requires an understanding of population dynamics and abundance yet such knowledge is often hindered by their elusive nature. The equatorial dry forest is one such biodiverse hotspot harboring several threatened mammal species for which there is a paucity of reliable data, including Andean bears. Their populations have declined significantly and may be isolated due to habitat loss as a result of human population expansion and migration from the Andes.

We estimated demographic parameters of an Andean bear population in the dry forest of northwestern Peru using radio-telemetry, direct observations, and camera traps in the 350-km2 study area. We obtain 5581 observations of 57 known bears in between 2008-2018. Density was estimated from a camera trap grid using spatial capture-recapture (SCR) while age-specific survival and fecundity were estimate from observations at waterholes and dens.

Bear density was estimated to be 7.1 ± 1.3 ind. 100 km-2. Estimated annual survival probabilities were similar for adult males (ϕmale=0.854±0.044) and females (ϕfemale=0.794±0.054), but were lower for juveniles (ϕjuvenile=0.693±0.163) and subadults (ϕsubadult=0.647±0.133) and much lower for cubs (ϕcub=0.256±0.090). Average litter size was estimated at 1.15 (SE 0.07; range = 1–2 cubs) and the average interval between two successive litters was 27.4 months (SE 2.5; range = 13–45 months).

Low female and cub survival, combined with small litters and large interbirth intervals, suggests that this population may be threatened by poor maternal condition, small population size and other anthropogenic factors in the region, underscoring the urgent need for strategic conservation planning, ecological monitoring, and habitat protection and restoration within this biodiverse hotspot.

PRE-RECORDED SESSIONS

1. APPLIED CONSERVATION SOLUTIONS

DEVELOPMENT AND VALIDATION OF PROTEIN BIOMARKERS OF HEALTH IN GRIZZLY BEARS

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Large carnivores play critical roles in the maintenance and function of natural ecosystems; however, the populations of many of these species are in decline across the globe. Therefore, there is an urgent need to develop novel techniques that can be used as sensitive conservation tools to detect new threats to the health of individual animals well in advance of population-level effects. Our study aimed to determine the expression of proteins related to energetics, reproduction, and stress in the skin of grizzly bears (Ursus arctos) using a liquid chromatography and multiple reaction monitoring mass spectrometry assay. We hypothesized that a suite of target proteins could be measured using this technique and that the expression of these proteins would be associated with biological (sex, age, sample location on body) and environmental (geographic area, season, and sample year) variables. Small skin biopsies were collected from free-ranging grizzly bears in Alberta, Canada from 2013-2019 (n=136 samples from 111 individuals). Over 700 proteins were detected in the skin of grizzly bears, 19 of which were chosen as targets because of their established roles in physiological function. Generalized linear mixed model analysis was used for each target protein. Results indicate that sample year influenced the majority of proteins, suggesting that physiological changes may be driven in part by responses to changes in the environment. Season influenced the expression of proteins related to energetics, reproduction, and stress, all of which were lower during fall compared to early spring. The expression of proteins related to energetics and stress varied by geographic area, while the majority of proteins that were affected by biological attributes (age class, sex, and age class by sex interaction) were related to reproduction and stress. This study provides a novel method by which scientists and managers can further assess and monitor physiological function in wildlife.

BEAR ID; AUTOMATED FACE RECOGNITION FOR INDIVIDUAL IDENTIFICATION OF BEARS

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Computer vision increasingly supports analyses of big data collected from image-based ecological studies. Concurrently, widespread deployment of remote camera traps can address questions related to population and community ecology, animal behaviour and conservation research. One challenge of image-based data, however, is the inability to distinguish among individuals for species that lack unique pelage markings. Facial recognition has been developed to address this challenge but has yet to be applied extensively beyond primates.
We are developing an open-source application (BearID) that can provide a highly adaptable and cost-effective method of monitoring bears. We provide an update on our project developing facial recognition technology for bears, by focusing on object detection: a critical part of automated photo-ID. We developed a multispecies face detector for use in individual photo-ID of all eight bear species, using existing images of bears taken under human care (n = 2192). We tested the transferability of the multispecies detector on a wild brown bear (Ursus arctos) dataset and prototyped integrating the detector into a pipeline of individual ID for a new species, the Andean bear (Tremarctos ornatus).
Using deep learning, the trained face detector achieved an average precision (AP) of 0.91-1.00 across all bear species. The detector was transferable to images of wild brown bears (AP = 0.93), and for a full pipeline, Andean bear individuals were correctly identified in 86% of test images. We provide these results as proof-of-concept for achieving high performance with multispecies-trained networks for face detection and individual ID, which could speed-up the transferability and application of this technique. Individual identification using facial recognition approaches offer a promising tool for use in research and monitoring of bears.

EFFECTS OF LANDSCAPE CHANGE ON GRIZZLY BEAR MOVEMENT BEHAVIOR: INTEGRATING AGENT-BASED MODELING AND MULTI-SCALE DECISION MAKING

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Given current rates of anthropogenic environmental change, there is a vital need to understand wildlife movement and behavior in response to human activity to inform conservation efforts. In particular, determining how animals learn about their environment and what role this learning plays in adapting to new landscape conditions is critical. Our research focuses on the grizzly bear (Ursus arctos) population of west-central Alberta, a threatened population currently being exposed to rapid development and change. Using computer simulations rooted in agent-based modeling (ABM), this project describes how movement patterns arise from a complex multi-scale decision process that incorporates dynamic landscape variables. ABM emphasizes individual decision-making and the emergence of patterns based on interactions between individuals within a system and between individuals and their environment. The use of multi-scale decision-making reflects the complex ways in which grizzly bears account for both small- and large-scale knowledge about their surroundings while moving through an area. This knowledge is obtained through a reinforcement learning mechanism that simulates how bears gain knowledge about their environment and use that to make informed movement decisions in the future. Understanding this learning process is helping us study how grizzly bear adaptability to changing landscapes affects their success in new environments. Our findings are currently being applied to translocated bear movement and are informing conservation policies that dictate translocation procedures.

2. BEARS OF THE WORLD: DISTRIBUTION AND CONSERVATION STATUS

UNRAVELING THE MYSTERY OF THE GLACIER BEAR: GENETIC POPULATION STRUCTURE OF BLACK BEARS WITHIN THE RANGE OF A RARE PELAGE TYPE

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Glacier bears are a rare color morph of black bear found only in Northern SE AK and the Yukon. We examined contemporary population structure of black bears within their range and how this structure related to pelage color and biogeographic features of a recently glaciated and highly fragmented landscape. We genotyped 284 bears using 22 microsatellites extracted from noninvasively collected hair as well as tissue samples from harvested bears. Our objectives were to identify the number and geographic ranges of black bear populations within the range of glacier bears and assess the level of admixture and migration between populations. Further, we examined the relationship between the geographical ranges of different genetic populations and pelage color, which appears to be heterogeneous across the landscape. We determined the range of glacier bears and found ten populations of black bears in the study area, including two new populations not previously identified, separated largely by geographic features such as glaciers and marine fjords which has significant implications on future genetic connectivity as glaciers rapidly shrink. Six populations were within the glacier bear range including four which contained individual glacier bears. Lack of geographic continuity and lack of genetic relatedness between black bear populations containing glacier bears suggest a possible unsampled population or an association with ice fields. Further investigation is needed to determine the genetic basis for the adaptive and evolutionary significance of the glacier bear color morph to help focus black bear conservation management to maximize and preserve genetic diversity.

THE ROLE OF PRIVATE LANDS IN ANDEAN BEAR CONSERVATION IN THE SOUTHERN SECTOR OF SANGAY NATIONAL PARK, ECUADOR

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Protected areas may prove insufficient to protect wildlife that have some part of their range outside of park boundaries. Private lands next to protected areas may play an important role in the conservation of large carnivores when they provide an extension of habitat and other resources. Andean bears (Tremarctos ornatus) are globally threatened and locally endangered in Ecuador, where their presence on private lands is well-documented. The objective of our study was to explore how private lands with low levels of reported human-bear conflict and suitable habitat are used by bears. Do they complement bear habitat in protected areas? Or does proximity to humans deter them? From 2012-2014 we used camera traps to survey bear presence in the Nudo del Azuay region of Ecuador, where privately owned land is inside the southern border of Sangay National Park. Our study area (40 km2) was a matrix of primary and secondary forests, shrublands, páramo, and pastures. We surveyed landowners and built models to test human influence and habitat features against bear presence and then used a negative binomial regression with integrated nested Laplace approximation (INLA) to test our models. We detected Andean bears at 45% of camera traps sites on 69% of participating properties. Andean bear presence was positively associated with an increase in distance from areas of high human-use and low-quality bear habitat, as well as with study year two, potentially indicating an annual shift in resource use in our study area. Andean bears are somewhat disturbed by human activities but habitat and access to annual changes in resources might be more important when planning for bear conservation on private lands adjacent to protected areas. Work with private landowners in agricultural zones with critical Andean bear populations could also incorporate land use and management incentives to minimize human-bear interactions.

VALUE OF DATA FOR ANDEAN BEAR DISTRIBUTION ESTIMATIONS FOR PERU

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Species distribution models (SDMs) are popular tools to provide fundamental ecological information applicable to species conservation. However, SDMs require large amounts of high-quality occurrence data which may not be always available for some less studied bear species as the Andean bear (Tremarctos ornatus). Andean bear field studies in Peru have been concentrated in some areas of its known distribution, but outside of those areas, spectacled bear information mostly consists of opportunistic and scattered records that are usually missed by researchers and managers. Here I compiled and created an open source database for Andean bear records in Peru from different sources. I used Andean bear presence records from 2000 to 2018 from gathered from refereed journals, gray literature, and unpublished researcher's and managers data. I modeled the Andean bear distribution using methods to evaluate the effect of not including (dataset 1, 743 records) or including (dataset 2, 909) unpublished records and compared the results. Model predictions varied among methods and among datasets, the dataset including unpublished records showed more connectivity and a larger distribution area. Predictions including unpublished data showed that spectacled bear distribution includes Central Peru, an area not included by previous assessments or by predictions using only published Andean bear records. Although occurrence data collected by standardized methods will be always preferable, we can take advantage of commonly overlooked data, especially while working with rare or poorly studied species such as the Andean bear. More efforts in data availability can help to improve estimations for current and futures studies in special with limited financial resources and time.

USING MICROSATELLITE META-ANALYSIS TO UNDERSTAND SPATIAL PATTERNS OF GENETIC DIVERSITY IN EIGHT BEAR SPECIES

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Microsatellites have been used to study bear populations in all eight species. These genetic markers are particularly useful for estimating genetic diversity (including observed homozygosity (HO), allelic richness (A), and inbreeding coefficient (FIS)), relatedness coefficients, population structure, gene flow rates, effective population size (Ne), and estimating census population size via genetic mark-recapture. North American bears were some of the first wildlife species for which panels of microsatellites were developed; thus, those loci have been used extensively, but not exclusively, in ursid studies. One challenge of microsatellite studies is that they are not comparable between labs without genotyping reference samples. The ability to compare genetic diversity across geographic ranges and/or species would aid in conservation of the world's bear species. We present a meta-analysis of 104 microsatellite studies representing 395 populations of bears from all eight species. Both the number of publications and number of populations studied are skewed towards the American black bear (Ursus americanus), where the least work has been completed on the sun bear (U. malayaus). We identified 203 different microsatellite loci used to genotype bears where 134 loci have only been genotyped in a single species. We show how genetic diversity of HO and A vary spatially within species, then link that information to monitoring and conserving genetic diversity. We also highlight understudied species and populations.

3. CONNECTIVITY

HOW TO CREATE A SAFETY NETWORK FOR NATURE: CONNECTIVITY CONSERVATION FOR THE JEWEL OF EUROPE

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The Carpathian Mountains in Central and Eastern Europe are one of the world's most biodiverse and intact wild places, stretching across seven countries (Czech Republic, Hungary, Poland, Romania, Serbia, Slovakia, and Ukraine). The Carpathians are home to over 40% of continental Europe's brown bear population (estimated at over 7,000 individuals) crisscrossing some of the last remaining virgin and old growth forests excluding Russia and Belarus. Due to their ecological significance as an apex predator and the management challenges that extremely high population densities imply, there is an abundance of high-quality spatial data for the brown bear in Romania. Thus, we brought together diverse stakeholders to participate in the first-ever ground-testing exercise of forthcoming IUCN guidance for designing, governing, and managing for effective ecological connectivity (developed by the IUCN WCPA Connectivity Conservation Specialist Group) and we used brown bears as a model species to explore solutions for ecological connectivity conservation to serve multiple species and habitats. Fine-scale maps of landscape resistance, GPS telemetry datasets and least cost path modelling for multiple species (brown bear, wolf, lynx and prey species) were used to identify areas of priority for connectivity, and we compared this information to the extent, configuration, and management of the current ecological network. These recommendations in terms of design, governance, and management range from considering the wide variety of uses including existing management and protections within a particular area of ecological connectivity, forming stakeholder coordinating mechanisms, and the integration of avoidance and mitigation measures in the earliest stages of highway infrastructure planning and design. Outcomes of this groundbreaking exercise are designed to motivate action beyond national borders. As more than 50% of the Carpathian ecosystem is found in Romania, it is positioned to take a leadership role in connectivity conservation in much of Europe. The potential exists in replicating the usage of the IUCN guidance in other nations and regions to ensure effective delivery and consistent implementation of ecological connectivity practices.

RESTORATION OF TRANSBORDER CONNECTIVITY BETWEEN TWO LARGE BROWN BEAR POPULATIONS

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Knowledge about the connectivity among populations is essential to identify management units for their conservation but also for effective management actions. Conservation minded management led to the recovery of large carnivore populations in northern Europe, putatively restoring connectivity between the two separated, but expanding brown bear (Ursus arctos) populations of Scandinavia in the west and Karelia in the east.

We tested the assumption of restored connectivity by focusing on the dispersing sex and assessed genetic connectivity across the transborder area where these two populations presumably meet. Using existing genetic monitoring data and samples, we increased the number of microsatellite markers to twelve and genotyped additional samples to achieve continuous sampling over the latest generation (N=924, 2005-2017). Of those, 824 individuals were also genotyped with eight Y-chromosomal microsatellites to reveal distinctive male lineages.

Our results showed that the two populations are not genetically isolated as reported by earlier studies. We found evidence of migrating individuals from Karelia to Scandinavia for the first time. Recent, asymmetrical gene flow of 1% rate (4.6-5.5 individuals) was detected from Karelia into Scandinavia, while there was a rate of about 8% (27.1-34.5 individuals) from Scandinavia into the Karelian population. Indirect methods, reflecting historical gene flow, estimated an effective number of migrants between 1.3 to 2.5 individuals per generation between both populations. The assessment of Y-chromosomal markers showed a similar picture, with comparably more brown bears carrying distinctive haplotypes from Scandinavia being identified in the Karelian population.

Successful recovery and expansion of both populations led to the restoration of connectivity. However, connectivity is asymmetric and the influx from Scandinavia to Karelia is considerably higher than expected, likely due to different recovery histories. Our study shows that transborder assessment is crucial to reveal the status of large, recovering populations and authorities should harmonize methodologies for transborder monitoring.

EFFECTS OF SEA ICE FRAGMENTATION ON INDIVIDUAL VARIATION IN POLAR BEAR MOVEMENT IN HUDSON BAY

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Habitat fragmentation can impede an animal's ability to move through their habitat, affecting both local and long-distance movements. Each year, polar bears (Ursus maritimus) migrate to refuge habitats on land or to multiyear ice as annual sea ice breaks up. We used polar bear telemetry location data from 39 adult female polar bears tracked in Hudson Bay in 2013−2018 during break-up (2 May−23 July) to show variation in migratory movement and timing as break-up advances. We separated break-up into early and late periods and used standard deviation in temporal spatial autocorrelation (SASD) of sea ice concentration to quantify sea ice fragmentation. Higher spatial autocorrelation reflects dissimilarity in local habitat composition at a single point in time, while SASD reflects variation in local habitat composition over time. In late break-up, there was a significant positive correlation between polar bear path tortuosity and SASD. Individuals arrived on land significantly later when paths moved through sea ice with increasing SASD in late break-up. Reproductive status of adult female polar bears had no effect on the variability of the sea ice an individual travelled through. SASD provides a means of summarizing the complexity and dynamics of sea ice habitat and can be used to understand variation in movement and ecology of ice-associated organisms.

SPACE USE, MOVEMENTS AND ACTIVITY PATTERNS OF AN ANDEAN BEAR (TREMARCTOS ORNATUS) TRACKED WITH A GPS COLLAR IN A FRAGMENTED LANDSCAPE AT THE COLOMBIAN ANDES

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The space use performed by wildlife species involves the animal's cognitive map of its environment, which could vary depending on variables as habitat availability. Telemetry applied to biology has improved spatial ecology knowledge on the species, useful for wildlife management and conservation. We provide data on the first Andean bear tracked with a GPS collar in Colombia, in a highly fragmented landscape at the Chingaza massif, comprising forests, highland shrublands, grasslands, and Paramo vegetation covers. We hypothesized that certain attributes of the space use of the species could vary due to cover types characteristics. Space use measurements (movements, activity, home range, core area) were calculated using Q-GIS and adehabitatHR package on R. A total of 341 GPS locations were obtained between October-December 2013 before the collar stopped working. The estimated home range and core area for the individual were 238.86 km2 and 140.38 km2 (respectively), almost doubling those reported for the species at a much less fragmented area in Ecuador, agreeing with the idea that more fragmented landscapes demand greater movements from the individuals for obtaining accurate resources. The density of GPS locations (%), the area covered by the bear's path (km2), and the amount of hours spent (hrs) were calculated for each cover type, being higher for shrublands (63%; 234.62 km2; 570 hrs), followed by Paramo (27; 169.97; 121), forests (7; 1.669; 36) and grasslands (4; 0.5818; 11). The low amount of forest coverage at such a fragmented landscape could induce an increasing use of the forest-Paramo ecotone, which during the tracking months contained lots of fruiting Ericaceae shrubs. The greatest activity was recorded between 5:00-19:00 hours, in agreement with previous reports. Finally, total daily routes oscillated between 0.51-12.07 km.

CHARACTERIZING DRIVERS OF FINE-SCALE RESOURCE SELECTION IN A RECOLONIZING BLACK BEAR POPULATION

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Large carnivore extirpations and population reductions have occurred globally in the last century. However, in many areas, large carnivore populations are rebounding. In Missouri, American black bear (Ursus americanus) numbers have been increasing since near extirpation, creating a need for management and conservation planning. Understanding the driving forces behind fine-scale movement and behavior of this large carnivore is an important step in this endeavor. We used GPS collar data collected from 2011-2018 to examine Missouri black bear (n = 71 bears) resource selection using an integrated step selection framework. We examined if selection was driven by: i) the avoidance of risk from roads and humans, ii) landscape productivity, iii) habitat fragmentation, or iv) landscape features known to facilitate carnivore movement. Considering individual responses can vary due to landscape spatial heterogeneity, sex, age, or level of maternal care, we examined selection across individual bears. Black bear resource selection was mediated by several drivers, with most bears (37% of individuals) selecting for contiguous forests, followed by risk avoidance (28%) and food abundance (27%). Drivers of selection were not related to spatial placement on the landscape but rather individual characteristics, with young males focusing on food resources, while older males selected contiguous forests. In contrast, females demonstrated risk avoidance and occupied contiguous forests when caring for cubs but had no patterns in drivers of selection when they had yearlings. By improving understanding of landscape features preferred by black bears we will characterize areas likely to be colonized by this large carnivore, which will help inform management decisions, including decisions related to human-bear conflict mitigation.

4. HUMAN-BEAR INTERACTIONS AND MANAGEMENT

EXPLORING CONSERVATION ISSUES RELATED TO THE EFFECTS OF BEAR VIEWING ON BEARS

Lana Ciarniello

In British Columbia (BC), Canada, commercial grizzly bear (Ursus arctos L.) viewing is an important source of revenue and uncontrolled growth of the industry is occurring. A lot of the appeal in viewing bears is predicated on the belief that the industry is “ecotourism” and “non-consumptive”- bears are shot with cameras rather than guns. However, to utilize viewing areas bears must co-exist with humans and viewing could make bears more susceptible to population declines. The BC Auditor General has called for regulation of the industry but no standard methods exist for monitoring the impacts of viewing on the bears themselves. From August 2015-2017, I examined how viewing affected the social dominance hierarchy and the daily behavioural patterns of grizzly bears using a full occupancy viewing operation. The study occurred within the 3.3-km2 territorial reserve land of the Homalco Nation (Xwemalhkwu). Tours began mid-August, coinciding with prolific runs of spawning salmon (Oncorhynchus spp.), and received 3,600 viewers in 66 viewing days (n = 3,072, 3,766, 3,953). In a paired sample design, 8 infrared motion-activated cameras were aimed at barb wire stations on rub trees and along bear trails. Fifty-two grizzly bears (23M:29F) used the viewing area (further DNA results pending). Twelve bears were previously detected in other studies, located 16-67 km from the viewing area. Grizzly bear behaviour followed a bimodal circadian pattern of activity, being less active mid-day (13:00-16:00) and at night (22:00–06:00), which is consistent with studies on non-viewed bears. However, bear activity temporally shifted decreasing at 08:00 just prior to the arrival of tourist and increasing at 16:30. Adult males were less likely to be viewed during peak tourism hours but well placed refugia areas allowed bears to remain in the viewing area. This work can be used elsewhere for monitoring programs, bear viewing guidelines, regulations and facility design.

EFFICACY OF BEAR DETERRENT SPRAY VERSUS POLAR BEARS

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Understanding the effectiveness of deterrents in mitigating human-polar bear (Ursus maritimus) conflicts is critical to ensuring both human safety and polar bear conservation. Although considerable attention has been focused on understanding black (U. americanus) and grizzly (U. arctos) bear conflicts with humans, there have been few attempts to systematically analyze information on the use of deterrents on polar bears. In an effort to fill this knowledge gap, we analyzed bear-conflict data to evaluate the effectiveness of bear deterrent spray versus polar bears. We analyzed demographics and body condition of bears involved, and probable cause of 18 incidents involving the use of bear spray on wild polar bears from 1986- 2016 in Canada, Russia, and the United States. In 94% of close-range encounters with polar bears, bear spray stopped the undesirable behavior. The only failure to deter a polar bear occurred when wind prevented the plume from reaching the bear, which is consistent with previous findings for brown and black bears where wind affected spray performance in 6-7% of deployments. Additionally, in 62% of incidents, other nonlethal deterrents were used without success prior to effectively using bear spray. Importantly, no humans or polar bears were killed or seriously injured in any of the incidents in which bear spray was used. We also analyzed 32 incidents of polar bear attacks on humans and found that in 75% of incidents, use of bear spray may have been possible given the circumstances leading to the attack. This work represents an important step towards improving our understanding of effective tools for polar bear conflict mitigation. Continued collection and analysis of range-wide data on polar bear conflicts will help increase human safety and ensure the conservation of polar bears for future generations.

GRIZZLY BEAR HABITAT SELECTION IN CANADA'S BUSIEST NATIONAL PARKS

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Visitation in Banff, Kootenay, and Yoho National Parks is over five million visitors annually. Understanding how resident grizzly bears (Ursus arctos) navigate the landscape among millions of people supports management decisions that promote bear conservation and minimize conflict. We examined how the level of human use on recreational trails affects grizzly bear habitat selection in these parks. We analyzed GPS collar data from 2012 to 2015 from 27 grizzly bears and 423 remote camera locations on human use trails over 8,278 camera trap days. We used the camera data to estimate human use on all trails, categorize trails as low or high use, and to define a threshold of human use beyond which grizzly bear use was significantly less likely. The predicted human use model was then used as a covariate in a step selection function (SSF) to assess its influence on grizzly bear habitat selection around low and high use trails. The SSF revealed that grizzly bears consistently selected for habitats with high quality forage and low road density (defined by previously estimated resource selection functions fit to data from different bears). We found a high degree of individual variation in grizzly bear habitat selection in relation to trails: most bears selected areas closer to low use trails (n= 12) but only some bears avoided high use trails (n= 7). Breakpoint regression analysis suggested a threshold of eight daytime human events after which bears reduced trail use. Grizzly bears were willing to access habitat near human activity, showing a degree of tolerance for humans. This pattern of selection could increase risk of human-bear interactions, habituation and conflicts. Our findings expand-upon previous models by Gibeau (2000) regarding the influence of human trail-use on grizzly bear habitat selection in busy park landscapes.

SURVIVAL OF AMERICAN BLACK BEARS POST REHABILITATION

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Scant information regarding the fate of rehabilitated American black bears (Ursus americanus) post-release exists in the literature. We estimated survival of 28 rehabilitated bears that were released between 2015-2018 and investigated what biological, landscape, and behavioral factors influenced their survival in their first-year post-release. Sixty-one percent of the bears died within 1 year and 65% of the mortalities were from legal hunter harvest. Road density and the percent of developed land were the leading influences on bear survival. Because few mortalities were attributed to vehicular incidents, road density likely acts as proxy to hunting accessibility. In urban areas, ordinances and small parcels tend to restrict the opportunity for hunting which may create a refugia for some black bears. Our results also indicate that female rehabilitated bears may be more susceptible to hunting pressures than wild females. Release weight had a positive effect on survival; heavier bears were likely less attracted to anthropogenic food sources (e.g., crops, bird feeders) that would have made them susceptible to hunters compared to more reliable, natural food sources. Individuals that moved slightly more than average in our study had a lower survival probability. A bear displaying a more tortuous movement pattern may be more prone to harvest as it would move frequently but remain in the same area. We recommend selecting releasing bears in the late summer or early fall of the capture year at release sites that limit harvest via accessible roads. If bears are released in the year after capture, we recommend ensuring 1.25 to 1.5 years old bears are ≥71 kg at release to enhance survival probability. Our results add to the growing body of bear rehabilitation research and can inform programs in which rehabilitation is critical to species restoration efforts.

5. HUMAN-BEAR INTERACTIONS AND MANAGEMENT

PREVALENCE AND PREDICTORS OF BROWN BEAR LIVESTOCK DAMAGE IN THE EASTERN ROMANIAN CARPATHIANS

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Identifying pathways to mitigate human-carnivore conflict is a key component for ensuring coexistence of people and wildlife in human-dominated landscapes, such as the Romanian Carpathians. In particular, livestock damage affects rural people disproportionately, and there is an increasing need to evaluate the spatial and temporal patterns of livestock damage and identify landscape factors that might influence the prevalence of conflict. Here, we compiled 756 reported livestock damage incidents caused by brown bears (Ursus arctos) (sheep, cattle and other domestic animals) from 2008 to 2016 in Eastern Romanian Carpathians (Covasna, Harghita and Vrancea counties). Within the 14,000 sqkm study area, 21.7% of livestock damage occurred within village limits, and damage was highly localized (7% of the area accounted for ~50% of the conflicts). Using logistic regression we identified damage predictors for sheep, cows and other domestic animals separately. For cows, likelihood of conflict increased with higher habitat heterogeneity, proportion of grazing lands, and was higher at high and low altitudes (corresponding to grazing areas and villages, respectively). For sheep, likelihood of damage was higher in areas with higher reported bear abundance, and in cases when sheepfolds were closer to the forest edge. For other domestic animals (pigs, chicken, rabbits) higher conflict occurred within villages embedded in heavily forested landscapes, where bear abundance was also high. Overall, the synergy between the human habitation context (e.g., villages in high and low altitude, close to forests), landscape context (e.g., habitat heterogeneity, grazing lands), and bear abundance leads to complex patterns of human-bear conflict. Mitigating human-bear conflict in Romania under the current regulatory context (i.e., targeted removal of problem individuals) will be dependent on both preventative actions (e.g., guard dogs, electric fences) and facilitating rapid intervention to remove habituated individuals.

ASSESSING THE EFFECTS OF CATTLE ON ANDEAN BEAR DISTRIBUTION IN A PROTECTED AREA IN NORTHWEST PERU

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Andean bears are threatened globally and play an essential ecological role as the largest carnivore in the Peruvian Andes. Andean bears require large and interconnected areas to persist, yet recently human-caused disturbances and persecution are reducing populations throughout the species range. Human disturbances in Andean bear habitats include grazing by free-ranging cattle, which are often found in protected areas; however, the effect of cattle on Andean bears has not previously been studied. In this chapter, I used detection data obtained from 61 camera traps active from August 2015 to April 2016, and remotely-sensed data on environmental variation (e.g., forest cover) to to assess the spatial relationship between cattle and bears in the Laquipampa Wildlife Refuge, a 8000 ha protected area in northern Peru. I used negative binomial generalized linear models to test the degree to which bear detection rate was related to the occurrence of cattle as well as several other hypothesized predictors of bear habitat use, specifically: elevation, slope, forest cover, proximity to towns, and proximity to agriculture,. Model selection based on Akaike's Information Criterion indicated support for candidate models in which bear detentions were negatively related to distance to towns, distance to agricultural fields, and relative abundance of cows.
Among the best models, distance to towns and agricultural areas were more important (higher Akaike weights) than the abundance of cattle, suggesting that in my study area, bears can coexist with a limited number of cows. My results highlight the importance of cattle management to secure the survival of Andean bears inside LWR. Additionally, the expansion of agricultural areas around the refuge should be controlled.

A SURVEY OF HUMAN-BEAR CONFLICT MANAGEMENT TECHNIQUES BY WILDLIFE AGENCIES IN CANADA AND THE UNITED STATES – 2019

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As bear and human populations increase, there is increased potential for human-bear conflict (HBC). The management of HBC is a serious issue confronting government, industry and the public in Canada, the United States and elsewhere because of the increased risk to people living and working in bear country, and the potential for loss of bears and bear habitat. It is important for wildlife agencies to continue to investigate HBC and to scientifically document and communicate successes and failures of their management strategies so other managers can efficiently develop and implement more effective protocols. We conducted a self-administered survey to assess how wildlife agencies respond to HBC and identified techniques currently used to manage HBC throughout Canada and the United States. Our objective was to compile and compare human-bear conflict management protocols throughout North America so wildlife management agencies and industry could learn from the experiences of other jurisdictions and update their own management protocols. Twenty-nine agencies responded to the survey and answered questions about bear populations, levels of complaints, types of interactions, and agency conflict response protocols. Although prevention is the preferred option to reduce conflicts, education, securing of attractants, aversive conditioning, relocation or removal of individual bears, or a combination of methods were used for both short and long-term conflict resolution. Results from our survey highlight each of the HBC management techniques used or tested and the benefits, challenges and successes of each technique. This survey builds on previous bear management protocols.

ASSESSING THE INFLUENCE OF A SPRING HUNTING SEASON ON BLACK BEAR HARVEST AND BEAR-HUMAN INTERACTIONS IN ONTARIO, CANADA

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Human-wildlife conflict can cause major declines in wildlife populations and poses a threat to human safety and livelihoods. Large carnivores are among the most conflict-prone species because they range widely, eat human-associated foods, and can pose a risk to human safety. Numerous approaches have been proposed for reducing conflict between humans and carnivores. Legal harvest of carnivores by licensed hunters is an attractive method to attempt to control rates of conflict because, if successful, it would be cost-effective, straightforward to implement, and could meet multiple wildlife management goals simultaneously. However, there is mixed evidence for the effectiveness of harvest in reducing conflicts. We analysed a unique management pilot project in Ontario, Canada in which a new spring black bear hunting season was implemented in selected wildlife management units in addition to the existing fall season. We examined human-bear interactions before and after this implementation in both treatment and control areas. Further, we examined the longer-term patterns of human-bear interactions and bear harvest before and after this experiment when a spring season was implemented throughout the entire province. We found that human-bear interactions and harvest were strongly related to the availability of natural foods in all analyses. The implementation of the spring season did not reduce interactions, and, in fact, interactions were higher in areas with the new spring season relative to control areas. These results show that regulated, sustainable harvest is ineffective at reducing human-bear interactions, and might increase interactions, although the mechanism for this increase was unclear. Further, our results support a long history of research showing that natural food availability is a primary driver of human-wildlife conflict. Programs promoting coexistence between people and wildlife, including education, capacity building and management of unnatural food sources will be the most successful at reducing conflicts.

6. BEARS OF EURASIA

BEARS, BEES AND HUMANS: A SHARED STORY ON THE TRADITIONAL APIARIES IN NW OF THE IBERIAN PENINSULA

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In the NW of the Iberian Peninsula there is a typology of apiaries that can be considered as unique in the world. These constructions seem to be conceived mainly with the purpose of keeping the beehives out of reach of brown bears (Ursus arctos). The existence of these constructions is registered in historical documentation several centuries ago, and its constructive typology has prehistoric characteristics. Despite the undoubted ethnographic interest of these apiaries, they have not received much attention by studious of cultural heritage. Surely this is because they are far from the human settlements. The “cortinos” or “alvarizas” - as they are named in a large part of the distribution area - are generally constructions of circular plant with walls several meters high, doors of small size (sometimes without door) and a protruding eaves. These apiaries are constructed following the traditional technique of dry stone (stacking stones upon each other, without using any other materials). The dry stone technique has been listed in 2018 by UNESCO as an Intangible Cultural Heritage. These apiaries generally house vertical beehives made with barks, wood or hollow trunks of trees. Its main distribution is restricted to Spain and Portugal, north of the Duero River, but the highest density is found in the provinces of Asturias, León, Lugo and Orense, overlapping in large areas with the current bear distribution. Actually we estimated that no remains more than 2,000 of these apiaries and that less than 300 have an acceptable state of conservation. The conservation of the best traditional typology but also the recovery of others allowing their combination with modern prevention systems (electric fences placed on the walls) could be a collaborative way from the culture and wildlife point of view. This cultural heritage is part of the history of the coexistence of bears and humans.

INVESTIGATION OF BROWN BEAR POACHING USING GENETICS SAMPLES IN MONGOLIA

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Bears are often killed due to their real and/or perceived threat, their valuable body parts (e.g. inner organs, paws and skin). Illegal hunting effect on the brown bears have not been evaluated in Mongolia. Our goal was to check the origin of illegally hunted bears and determine hunting pressure in each region and on each sex. We collected samples from brown bears illegally killed and confiscated by Mongolian officials. We sequenced 927 bp mtDNA and genotyped nDNA (13 microsatellites) of 100 samples from illegally killed which the origin of unknown samples. Forensic analysis included data from 144 individuals from 5 geographic region including Gobi Desert, Altai, Sayan, Khentii, and Ikh Khyangan mountains in Mongolia and Genbank data. Origin of illegally killed brown bears were from Altai, Sayan, Khentii and Buteeliin nuruu but not from Gobi Desert. Brown bears in Khentii and Sayan mountains were the most persecuted populations. This work provides an initial baseline for estimating illegal take and improving future conservation efforts and recommendations of brown bears in Mongolia.

POPULATION SIZE, MOVEMENTS AND ACTIVITY PATTERNS OF GOBI BROWN BEAR IN GOBI DESERT OF MONGOLIA

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The Gobi brown bear (Ursus arctos isabellinus) is geographically isolated in inaccessible harsh desert areas of Great Gobi A Strictly Protected Area in south-western Mongolia and have been studied very little. Two camera-trapping studies were conducted in the area from 05.2015 to 05.2017 and from 06.2018 to 09.2018. The first study aimed to determine seasonal and circadian activity of the species, and overlaps with other large mammals, and was conducted at six natural springs with five to eight cameras deployed on the each water source.We detected 13 species of large mammals, and Gobi bear was one of the most observed species with 1105 independent events recorded. Gobi bear showed a clumped seasonal activity in the area (Rayleigh test; $p<0.001$) with a peak around the first half of June (day 161.9±22.4). Active bears were detected from late March to early October. The circadian activity showed a clumped distribution with mainly nocturnal activity (01:26±2:17; Rayleigh test; $p<0.001$) not affected by the lunar phase, and overlap was detected with Eurasian lynx (Watson´s U test; $p=0.15$). The circadian activity pattern was similar across months (Pearson correlations always significant) but from September dawn and dusk peaks of activity were found. Based on this information a second study was designed in order to determine the population size during the period of greater activity at the main 13 natural springs in the whole protected area, grouped in three oasis complexes: Tsagaan Bogd, Shark hulst, and Atas Inges. 4451 pictures were evaluated by three researchers, and individuals were identified based on their shoulders-mark patterns. Average congruence among observers resulted in 33-36 individuals:15 adult males, 9 adult females, 5 unknown sex adults, 5 juveniles and 1 newborn. Only 4 males and 1 female were observed in more than oasis complex, as observed in previous studies.

CONSERVATION STATUS OF HIMALAYAN BROWN BEAR AND ASIATIC BLACK BEAR IN BHAGIRATHI AND BEAS RIVER BASINS, WESTERN HIMALAYA, INDIA

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Understanding the distribution and response of species to diverse human induced pressures is important for conservation planning and management of wildlife species in human-dominated landscapes. We assessed the distribution, relative abundance, and activity patterns of Himalayan Brown bear Ursus arctos isabellinus and Asiatic Black bear Ursus thibetanus in Bhagirathi (~ 11,000 km2) and Beas River basins (~1000 Km2) in western Himalaya, India. Both the river basins encompass a wide elevational gradient (500m to 4300m), a variety of habitat types, protection status, and a range of anthropogenic pressures. Systematic camera trapping (nested 4 x 4 km grids within 16 x 16 km grids) was carried out during 2015-2019 (camera trap sites = 284; trap nights=14,259). Brown bears (n = 91, 34 locations) were confined to elevations > 2500m in the alpine, subalpine and temperate forests. Asiatic black bears (n = 122, 52 locations) were distributed throughout except for the dry trans-Himalayan habitats. Photo-capture rates (#/100 trap nights) for black bear were 2.26 + 1.03 (SE) in Bhagirathi and 1.12 + 0.30 in Beas. For brown bears, it was 1.8 + 0.59 in Bhagirathi and 1.28 + 0.40 in Beas. In summer, black bear was nocturnal in both the river basins, whereas brown bear was crepuscular in Bhagirathi and diurnal in Beas. The extent of anthropogenic activities in both the river basins was high in summer. There was high temporal overlap of both bear species with livestock and feral dogs. We also recorded (N=12) range overlap between the two bear species during summer.
Although both the river basins encompass significant distribution range of both bear species, the distribution of bears overlapped with humans and associated activities both spatially and temporally, and thus these species remain vulnerable to anthropogenic pressures.

7. BEAR ECOLOGY AND BEHAVIOUR

IMPACTS OF ANTHROPOGENIC DEN DISTURBANCE ON BLACK BEAR BEHAVIOR AND CUB SURVIVAL

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Female American black bears (Ursus americanus) den throughout their range to birth and nurse cubs and to conserve energy during periods of low food availability. Den disturbance may result in den abandonment and reduced reproductive fitness. We monitored GPS-collared female bears and their VHF-collared cubs in Florida from 2017-2019. We documented female bear behavioral responses and cub mortalities after den disturbances by prescribed fire and research activities. Parturient bears denned 28 December to 14 April on average. Eleven dens were potentially disturbed by prescribed fire, causing 57% of females to temporarily leave the den (returning 7 to 11 hours later, on average). In one case, a female lost a litter to prescribed fire. Researchers disturbed 44 dens by quietly approaching the den close enough to hear or see evidence of cubs, usually within 20 to 30 m. Females showed little reaction to this approach, where only one bear fled the disturbance then re-denned soon after. Researchers also disturbed 42 dens by startling the female off the den to handle cubs. All bears initially fled this disturbance, but subsequent reactions were variable. Distance fled ranged from approximately 20 to 1850 m (average 375 m). Time away from den ranged from immeasurably short (0 - 2 hours) to several days (48 - 50 hours) and was on average 6 - 9 hours. On return, 18% of bears re-denned at the disturbed den site; 71% re-denned at a new den site an average 127 m away (15-790 m) 2.4 days later (0 to 15 days); 11% did not re-den but instead began post-den emergence activities. One female did not return, abandoning her single cub. Other possibly disruptive events like timber harvest, flooding, and recreation were not well-documented. Our observations show that cub mortalities were rare but female behavioral changes were common in response to anthropogenic den disturbance.

ECOLOGICAL RELEASE SUPPORTS THE EXPRESSION OF DEN BEHAVIOR IN URSIDAE

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Ecological release may be realized through realization of ecological opportunities associated with colonization of new habitats, key innovations, and/or antagonist extinct and is suspected to precede adaptive radiation. Behavior may drive adaptive responses to ecological opportunities and expose individuals to novel ecological conditions through their interaction with resources or new areas. Despite established theory of these evolutionary and ecological processes, few examples are present in the body of literature. We hypothesized that realized ecological opportunities and relaxation of selective pressures on seasonal energetic budgets supports the expression and variability of den behavior in Ursidae. To test our hypotheses we reviewed the evolutionary history, expression of maternal and facultative den behavior across species and within populations, and the fitness related mechanisms influencing these behaviors. We contextualize our results within extant species ecology demonstrating that variability in den behavior supports the relaxation of selection pressures on seasonal energetic budgets and the cost-benefit hypothesis of energy conservation. In doing so we provide support for a contributing mechanism to the rapid speciation observed in Ursidae following the Miocene-Pliocene transition. Knowledge of the evolutionary and ecological processes underlying trait expression is central to natural selection and our understanding of species diversity. Additionally, identification of selection pressures influencing this diversity may have practical applications of predicting ecological responses to novel selection pressures brought forth by climate change.

DECLINING SALMON USE BY THE COASTAL BROWN BEARS OF KATMAI NATIONAL PARK: IMPACTS OF RAPID ECOLOGICAL CHANGE ON AN ICONIC PREDATOR

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Coastal habitats across the globe are at risk from anthropogenic stressors that could threaten these disproportionately high-value ecosystems. To determine the potential consequences of changes in the marine environment on coastal systems, we examined the role of salt marsh and intertidal resources—two habitats heavily influenced by the marine environment but available to bears—on the diet and habitat selection of coastal brown bears (Ursus arctos). We collared 28 adult female brown bears in Katmai National Park, Alaska from 2015 through 2017, estimated their assimilated diets using stable isotopes and the mixing model MixSIAR, evaluated habitat use and selection using GPS data, and compared our results to historical isotopic and observational data to examine change through time. Annual assimilated diets were 27.5 + 7.3% salmon and 72.5 + 7.3% plant matter, which contrasted markedly with dietary estimates from 1989 that were 62 + 25% salmon and 31 + 19% plant matter. The number of observable bears at Hallo Bay also declined by 64% between 1998-1999 and 2015-2016. Increases in coastal human visitation, decreases in salmon abundance, and increasing numbers of warm water ocean events were all recorded in coastal areas during that time. We contend that large-scale changes within the marine environment, such as decreasing salmon populations, may have already impacted bears, and may be a harbinger of future change. The doubling of plant matter in the assimilated diets of healthy bears suggests vegetation resources may allow bears to adapt to changing conditions, and therefore plays an important role in bear conservation.

SHOULD I STAY OR SHOULD I GO? POST-RELEASE MOVEMENT BEHAVIOR AND HOME RANGE ESTABLISHMENT OF REHABILITATED BLACK BEARS

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Post-release movements and behaviors contribute greatly to the success of rehabilitated black bears (Ursus americanus). Potential for human-bear interactions can be reduced if bears are released in remote areas and do not disperse. We used 2 methods to determine whether 28 rehabilitated yearling bears released between 2015-2018 established a home range or remained transient. First, we evaluated various linear and Euclidean distances and classified a bear as a resident if its average daily movements were similar to the average distances for their particular sex and/or region. Second, we constructed annual and seasonal home range estimates using Dynamic Brownian Bridge Movement Models and classified a bear as a resident if it exhibited site fidelity for ≥1 season. We determined if sex, region, or release weight influenced the size of established annual home ranges. Male bears typically moved farther than females, and Mountain region bears typically moved farther than Coastal Plain bears. All bears showed equally tortuous movement patterns across regions and sexes. Based on distances moved, 4 Mountain region bears (t15 = 2.72–10.8 P = <0.0001– 0.0079, V15 = 0-29 P = <0.0001–0.0222) and 3 Coastal Plain bears (t6 = 2.34–5.52 P = 0.0007–0.0288, V6 = 0-3 P = 0.0078–0.0391) traveled greater distances than average—indicating transient behavior. Based on site fidelity, 1 male and 1 female bear from the Mountain region exhibited transient behavior. Home range areas were similar between sexes (W13,11 = 43 P = 0.1056). Mountain bears had home ranges 124% larger (W15,9 = 28 P = 0.0177) than Coastal Plain bears. Release weight positively influenced home range size (β' = 0.38, F1,22 = 5.88 P = 0.0239). Knowledge of post-release bear movements will inform management decisions by understanding how movements may affect nuisance behaviors.

THE USE OF TRIAXIAL ACCELEROMETERS TO IDENTIFY GRIZZLY BEAR BEHAVIOR

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Radio telemetry and GPS technology has allowed us to quantify bear habitat use and movement through increasingly complex models. However, even though GPS technology has enabled managers to increase GPS fix location frequency, there is still great uncertainty about bear behavior at and between GPS fix locations. The use of tip-switch activity sensors has enabled researchers to determine a basic activity level of bears but falls short of informing specific behaviors. Triaxial accelerometers have shown promise in recent years for both identifying behavior and estimating movement energy expenditure on a variety of species. As with any new technology, triaxial accelerometers have been relegated to short duration studies with power supply and memory capacity being limiting factors. Recently, triaxial accelerometers integrated into GPS collar systems have become commercially available and show promise for longer term deployment. We investigated the ability to identify bear behavior from bears wearing collars equipped with triaxial accelerometers. We deployed collars outfitted with triaxial accelerometers on nine captive grizzly bears (Ursus arctos) weighing 90 – 265 kg during an energetics study conducted across the active season. Bears were observed and behavior recorded for each animal using static and remotely operated video cameras. Behavior was scored and used to train and test classification algorithms from triaxial accelerometer data. We also evaluated triaxial accelerometer sampling rate to determine which behaviors were misclassified with lower sampling rates. These approaches will help researchers better understand the energetics, movement, and behavior patterns of free-ranging bears, how bears perceive their environment, and ultimately the cost of human activities to the well-being of bears.

VARIATIONS IN GRIZZLY BEAR MOVEMENT IN RELATION TO THE DAILY AND SEASONAL AVAILABILITY OF ANNUAL VEGETATIVE FOOD RESOURCES.

Cameron Mcclelland

Nicholas Coops[1], Ethan Berman[1], Sean Kearney[1], Scott Nielsen[2], Cole Burton[1], Gordon Stenhouse[3]

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Determining seasonal and annual vegetation phenology and how the development of key vegetative food resources occur across the landscape is important in understanding grizzly bear movement and habitat selection. Within our changing climate changes in vegetation phenology may be occurring. In order to monitor these changes a fine spatial and temporal scale product capable of observing vegetation across an entire region is required. Landsat and MODIS (Moderate Resolution imagery spectroradiometer) have individually been used to monitor vegetation phenology, however in order to overcome inherent spatial resolution difficulties present in MODIS and temporal discontinuities present within Landsat we must fuse these two data sets. This research utilizes the Dynamic Time Warping (DTW) algorithm to quantify vegetation phenology at a 30m resolution at a daily time step over the entire Yellowhead region from 2000-2018. This product is entitled DRIVE (Daily Remote Inference of Vegetation) and was validated using a network of ground cameras. Through DRIVE it was determined that on average start of growing season is beginning earlier with a maximum trend of 0.78 days earlier per year. Using DRIVE are able to determine how changes are directly affecting grizzly bears by incorporating GPS collared bear data. We have also determined whether changes in individual food species are influencing grizzly bear movement. To accomplish this we have modeled annual species specific food layers for eight bear food species using maximum entropy models and extracted species availability windows using ground data and DRIVE. Through the use of these food layers and resource selection functions we have determined how habitat selection has varied annually over 3 years of varying mean annual precipitation. With this research, we will provide insight how food resources are changing across our landscape and how grizzly bears are being affected by these changes.

TROPHIC POSITION AND HUCKLEBERRY USE OF CABINET-YAAK AND SELKIRK ECOSYSTEM GRIZZLY BEARS (URSUS ARCTOS)

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Relative to other populations in the continental United States, Cabinet-Yaak and Selkirk (CYS) Ecosystem grizzly bears (Ursus arctos) likely rely to larger degree on huckleberries and other fruit items in late summer and early fall for mass and fat gain. Further, population-level use and importance of animal matter (i.e., meat) to CYS bears is assumed low (<10% of diet) but not fully understood. We hypothesized that both fruits and meat are important to nutrition and macronutrient balance, survival, and female reproduction of CYS grizzly bears. Using a long-term dataset (1983–2017), we analyzed bear hair and blood samples for isotope ratios of carbon (δC) and nitrogen (δN) from 206 grizzly bear captures and modeled these values relative to reference, discrimination-corrected isotope ratios of CYS grizzly bear food items. Using a unique nitrogen isotope ratio (δN) signature for huckleberries in the CYS, we obtained seasonal and sex-age class estimates of huckleberry and meat use by grizzly bears. We also collected and analyzed hair and blood samples from 146 captures (2014–17) of CYS black bears (Ursus americanus), to assess presence of contemporary interspecific competition for these same food items. We found 1) in limited cases and across sex-age classes, meat use provides a substantial increase and source of protein in fall months, 2) huckleberries contribute at least 20% of the overall assimilated energy balance of CYS grizzly bears during the active season, 3) no apparent evidence of complete scramble or contest competition for meat or berries between bear species, and 4) available berries and meat resources in the CYS have capacity to significantly influence fitness of female grizzly bears, especially given the smaller body size and energetic demand of CYS grizzly bears.

BEYOND POPULATION MEANS – INDIVIDUAL BEHAVIORAL AND DIETARY SPECIALIZATION IN SCANDINAVIAN BROWN BEARS.

Anne Hertel

Andreas Zedrosser, Andreas Mulch, Thomas Müller

"Recent research highlights the ecological importance of within-population individual-niche specialization. Individual specialization is commonly studied in relation to intraspecific dietary niche variation. The field of animal personality studies behavioral niche specialization as behavioral types, where individuals express a certain behavior consistently lower or higher than the population average. Here we present evidence for both dietary and behavioral niche specialization in the Scandinavian brown bear.

We used two distinct data sources to study individual specialization: a) we analyzed stable isotopes (δ15N) – an indicator for the degree of carnivory, measured in 393 bear hair samples repeatedly collected from 105 females, b) we quantified daily movement distance and diurnal activity from GPS movement and accelerometer data in 49 female bears tracked across 174 monitoring years. We used mixed effects models and double hierarchical mixed models to partition variance into environmental, among-, and within-individual sources.

We found conclusive evidence that female bears consistently differed in their degree of carnivory from individuals with a dominant vegetarian diet to those with a more carnivorous diet. Females also consistently differed in spatiotemporal behavior along a gradient of predominantly nocturnal individuals which moved on average over only half the daily distance as compared to more diurnal and mobile individuals in the population. These individual differences were not caused by heterogeneity in habitat composition, home range size, or age and furthermore, these differences persisted across monitoring years.

To date, estimates of predation rates or population connectivity largely ignore individual differences in diet and behavior but could gain prediction accuracy by incorporating individual niche specialization. Given that bears in our study differed in the timing and intensity of their primary activity, such information can be used for developing individually tailored management strategies."

HUMAN DISTURBANCE DISRUPTS HOME RANGE SEASONAL DYNAMICS IN BROWN BEAR.

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Bears are considered seasonal species. Important biological needs such as foraging activities, and biological events such as the onset of the mating season or the hibernation, follow seasonal patterns. Thus, bears may readjust their home range adapting to variations in their needs. The expansion of human activity has been shown to disrupt some of the natural behavioural patterns, such as movement and activity patterns, as well as foraging and hibernating in brown bears (Ursus arctos). Here, we aimed at characterizing the dynamics of the daily home range patterns in an environment with diverse human disturbances. We used GPS telemetry data from 29 brown bears from the Northern Carpathians tracked between 2013-2020, to describe the dynamics of the home range and its seasonal variation. We explored two home range components at a daily scale: the size and shifting distance of the location. We also investigated whether the seasonal dynamics of the home range components were affected by human-related factors. We found that daily home range size was positively correlated with the shifting distance, proving the dynamism of the home range pattern of North Carpathian brown bears. Both daily home range components showed consistent seasonal patterns, having minimum values at the beginning and at the end of the year and maximum values during the summer solstice. Females showed a more pronounced seasonal pattern than males. Human disturbance disrupted the seasonality of the home range of brown bears. Under human disturbance, while males tended to lose the seasonal pattern of the daily home range, females preserved the seasonality but flattening the pattern. Both females and males tended to lose the seasonal pattern of the daily shifting distance under the presence of human disturbance. Our results suggest that a better knowledge of the dynamism of their home range should help to preserve natural behavioural patterns and to reduce the overlap of human and animals' spatial use.

8. EX SITU CONSERVATION

ASIATIC BLACK BEAR RESTING METABOLISM AT THE SOUTHERN EDGE OF THEIR RANGE

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Metabolic rate (MR) is a fundamental property that reflects the total energy demand for all aspects of organismal function, from immune performance to reproduction. As a result, understanding metabolic rate is a key aspect of bear conservation; for example, the high field metabolic rate (FMR) of polar bears (Ursus maritimus) makes them particularly vulnerable to the loss of on-ice hunting opportunities while the relatively low FMR of giant pandas (Ailuropoda melanoleuca) has been used to estimate the food resources required (i.e. bamboo forest area) to support recovering populations. Asiatic black bears (Ursus thibetanus) are considered “Vulnerable”; however, little is known about their metabolism. Resting metabolic rate (RMR) is a measurement of the total amount of energy necessary for self-maintenance and therefore is an essential component of FMR. We hypothesize that the resting metabolic rate (RMR) of Asiatic black bears is similar to that of American black bears (Ursus americanus) due to their similar sizes and omnivorous diets. To determine Asiatic black bear RMR we are currently measuring the resting oxygen consumption and carbon dioxide production of captive individuals at the Cambodian Bear Sanctuary supported by Free the Bears and located within the Phnom Tamao Wildlife Rescue Center, Cambodia. Using positive reinforcement, the Asiatic black bears have been trained by husbandry personnel to rest in a custom-built metabolic chamber connected to sensors which records changes in O2, CO2, and water vapor concentration. Analysis is ongoing; measurements began in the cool season (January) of 2020 and will be repeated during the warmer, wetter months (May-August) with the same individuals for assessment of seasonal and intra-individual variation.

HUMANS AS A DISEASE RISK TO BEARS

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Human interactions threaten bears in numerous ways. Habitat encroachment, demand for bear parts, and human-bear conflict are all recognised conservation threats. Disease transmission to bears via humans is less commonly seen as a conservation threat. Across Southeast Asia sun bears (Helarctos malayanus) and Asiatic black bears (Ursus thibetanus) are regularly confiscated from the illegal wildlife trade and housed in rescue centres, bringing them into prolonged close contact with humans, as well as other wildlife and domestic species. Disease threats emerge at this interface which are not encountered as in-situ threats, but nonetheless can have a significant impact on conservation strategies. Thirty-one cases of tuberculosis were confirmed in sun bears and an Asiatic black bear at a wildlife rescue centre in Cambodia housing over 120 bears. Genotyping and epidemiological data have shown two different strains of Mycobacterium tuberculosis and the involvement of a human case in one transmission chain. Concerningly, one of the strains has significant drug resistance. A method was devised to quantify risk to the remaining population in order to focus surveillance efforts and resources. Diagnostic protocols have been appraised and refined for these species, in which tuberculosis is not previously reported. The impact of this, and other human-mediated disease risks, on the health and conservation management of these vulnerable species is significant. Lessons learned from this outbreak will inform critical risk analyses for evolving strategies for re-wilding these species in range countries.

THE ESSENTIAL ROLE OF ZOOS IN SUPPORTING CONSERVATION-RELEVANT POLAR BEAR RESEARCH

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Over the past 40+ years, scientists have overcome tremendous logistical challenges to study polar bears in the wild, providing essential information on population trends and effectiveness of harvest management. However, traditional research methods can be invasive and expensive. Further, deteriorating sea ice and less predictable weather from a changing climate means less stable conditions for field work. Thus, only by developing innovative modes of research can we keep expanding on the knowledge that is key to producing accurate estimates and projections of climate change impacts on the circumpolar polar bear population.
Polar bears in zoos provide a unique opportunity to fill critical knowledge gaps regarding polar bear biology within the fields of energetics and metabolism, costs of movement and nutritional stress, stress physiology, nutritional ecology, reproduction, and sensory ecology. Some opportunities are unique to zoos, including the ability to train bears for voluntarily sampling (e.g. of hair, saliva or blood). Zoo bears can be sampled multiple times over a longer period of time (longitudinal sampling) and can assist in essential calibration and validation of new methods and technologies. When combined with information from polar bears in the wild, such research can generate vital input to future conservation and management decisions.
Since the previous IBA conference, two groups have been established to help facilitate such in-situ/ex-situ collaborative research: The AZA SSP Polar Bear Research Council (PBRC) and the EAZA Polar Bear EEP Research Working Group. This presentation will introduce these two groups briefly before diving into one of their ongoing joint efforts; the development of a standardized polar bear tissue sampling protocol to be used in zoos, and the establishment of a long-term polar bear tissue bank for use in future ex-situ and in-situ research projects.

9. POPULATION ESTIMATION AND MONITORING

ADVANCES IN SPATIALLY EXPLICIT CAPTURE-RECAPTURE STUDY DESIGN FOR GRIZZLY BARS

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It is a challenge to sample bear populations using with sufficient intensity to achieve unbiased estimates of density with adequate precision. Spatially explicit capture-recapture (SECR) methods have relaxed some of the restrictions of previous closed model methods thus allowing adequate estimates with reduced sampling cost. However, potential biases still can occur due to non-representative sampling of target populations. We discuss sampling constraints and potential biases with SECR estimates and potential designs that meet sampling constraints and negate biases while reducing effort. Systematic grid, stratified sampling, and cluster sampling designs are evaluated using results from field studies of grizzly bears in Alberta and Nunavut. Potential hybrid designs that incorporate elements of systematic grid and cluster sampling are discussed. A challenge with SECR methods is assessing the adequacy of proposed sampling designs. Traditional simulation methods can be time consuming. Recent work shows how SECR detection parameter estimates may be used to predict the numbers of detections and re-detections for a proposed sampling design. Optimal sampling balances detection of new bears with re-detections. This approach, which is available in web-based software, allows efficient exploration of sampling designs compared to simulation approaches. We suggest that the best design depends on overall objectives as well as assumptions that can be made about regional distribution of the target population.

IDENTIFYING MECHANISMS OF POPULATION CHANGE IN TWO THREATENED GRIZZLY BEAR POPULATIONS.

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"Identifying the mechanisms causing population change is essential for conserving small and declining populations. Substantial range contraction of many carnivore species has resulted in fragmented global populations with numerous small isolates in need of conservation. We investigated the rate and possible agents of change in two threatened grizzly bear populations in southwestern British Columbia, Canada.

We estimated population density, trends, and the demographic components of population change for using DNA based capture-recapture data in both spatially explicit capture-recapture (SCR) and non-spatial Pradel robust design frameworks. The larger population had 21.5 bears/1000km2 and between 2006 and 2016 was growing λ=1.02 ± 0.02 SE) following the cessation of hunting while the adjacent but smaller population had 6.3 bears/1000km2 and was likely declining (λ=0.95 ± 0.03 SE).

Using data from GPS-collared bears to estimate reproduction, survival and demographic vigour (λ) in both populations. We identified both low adult female survival and low cub survival as the demographic factors associated with population decline in the smaller population.

Finally, we combine spatially explicit capture-recapture methods and models developed from resource selection modelling to estimate the effect of seasonal habitat availability and road density on the bear density in the two populations. We found that population density is most strongly connected to habitats selected during a season when bears fed on huckleberries, the major high-energy food bears eat during hyperphagia in this area, as well as a large baseline difference between populations."

MONITORING POTENTIAL ECOLOGICAL AND BEHAVIORAL RESPONSES WITHIN THE CHUKCHI SEA POLAR BEAR POPULATION TO 10 YEARS OF VARIATION IN SEA ICE HABITAT

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In 2008, a study of polar bears in the Chukchi Sea was initiated to inform management under a U.S.-Russia polar bear treaty, the U.S. Marine Mammal Protection Act, and the Endangered Species Act. Over a ten-year period (2008-2017), 401 polar bears were captured, weighed, and sampled for diet assessment on the sea ice off the western coast of Alaska. During this time there was a 2% per year decline in extent of spring sea ice but no trend in the extent of summer sea ice. Body mass of independent male and female polar bears exhibited no relationship over time nor did it vary in association with annual summer or spring sea ice extent. However, cub body mass declined and was related to the extent of summer sea ice habitat. The number of cubs per female was related to cub and adult female body mass suggesting that cub survival during the first year may be associated with prey availability. Litters were male-biased with singleton litters composed of 72% males and larger litters of 62% males indicating that recruitment may be higher for males than females. Diet estimates based on quantitative fatty acid analysis indicate that dietary diversity may provide flexibility to cope with variable prey availability associated with varying sea ice conditions. Increased cetacean strandings in the region were associated with higher proportions of gray and bowhead whale in diets and 21% of adult male diet was composed of walrus. Rapid declines in spring sea ice, which were most pronounced during the last 3 years of the study, were associated with reduced feeding frequency in adult females. This study provides baseline data for population monitoring as sea ice loss continues and insight on mechanistic relationships between sea ice habitat, foraging ecology, and individual condition.

MONITORING HIMALAYAN BROWN BEAR (URSUS ARCTOS ISABELLINUS) POPULATION BY HIGH-THROUGHPUT NONINVASIVE GENOTYPING

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The Himalayan brown bear (Ursus arctos isabellinus) population spanning the northern and southern flanks of Himalaya in Pakistan and India is considered Endangered in the IUCN's Red List under criterion D (very small or restricted population). The total population is estimated at 130-220 bears, but most live in isolated habitat patches with <10 individuals. It is among the least studied brown bear populations worldwide. The IUCN Bear Action Plan (1999) recommends development of efficient and reliable survey methods for regular monitoring of bears. To address this critical requirement, we used the new genotyping approach based on high-throughput sequencing (HTS) of amplicons of short tandem repeats (STR) and a sex marker to estimate abundance and sex-ratio of Himalayan brown bear population in Kugti wildlife sanctuary in India from non-invasively collected samples. We collected 72 fecal and 2 hair samples in spring 2019 (May-June) and successfully genotyped over 90% of samples at 13 loci. We detected 18 individuals (7 males, 11 females), many of which were recaptured multiple times (average recapture rate 3.28 captures per individual). We present abundance estimates based on spatial (SECR) and non-spatial (Capwire) approaches and discuss the efficacy of HTS genotyping for monitoring of bear populations in Himalaya.

DENSITY, ABUNDANCE AND DYNAMICS OF THE ENTIRE SCANDINAVIAN BROWN BEAR POPULATION

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Reliable estimates of population status are a pre-requisite for informed wildlife management. However, abundance estimates can be challenging to obtain, especially for species that are highly mobile, rare and elusive. For nearly two decades, management agencies in Norway and Sweden have been monitoring populations of three large carnivores, including brown bear (Ursus ursus), using non-invasive genetic sampling (NGS). Project RovQuant was initiated in 2017 with the objective to develop statistical methods that allow a comprehensive assessment of population status and dynamics using NGS data and other sources of information at very large spatial scales.
We developed a Bayesian open-population spatial capture-recapture (OPSCR) model that, using a combination of NGS and recoveries of dead carnivores, jointly estimates 1) the spatial variability in the probability of genetic detection, 2) the spatial distribution and interannual movements of individuals and 3) population size and dynamics. We fitted this model to the extensive individual-based monitoring data for bears which had been compiled by the national monitoring programs in Sweden and Norway between 2012 and 2018.

The unique Scandinavian data set combined with a novel OPSCR model allowed RovQuant to quantify the population status of bears at an unprecedented spatial scale (526 000 square kilometers). Despite discontinuous monitoring in Sweden, the OPSCR model yielded annual density maps and both total and jurisdiction-specific population sizes estimates. For example, the estimated number of bears in 2018 was 2 757 (95% credible interval, CrI: 2 636 - 2 877), of which 2 615 (CrI: 2 499-2 732) were located in Sweden and 142 (CrI: 124-162) in Norway. Annual cause-specific mortality and recruitment were also estimated, which are both useful metrics of the population's status and trajectory.

WHAT CAN FLIES TELL US ABOUT BEARS? THE USE OF INVERTEBRATE-DERIVED DNA IN BEAR MONITORING

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Large carnivore monitoring can be extremely challenging in areas where the target species is found in low densities or is particularly elusive. Non-invasive genetic sampling of such species presents a challenge due to limited sample collection possibilities, surveyor skills and the potential degradation of genetic material when exposed to the environment. This project aims to evaluate the use of invertebrate-derived DNA (iDNA) as an alternative method to more traditional techniques for monitoring the presence of elusive large mammals, in this case four bear species: brown bear (Ursus arctos), spectacled bear (Tremarctos ornatus), Asiatic black bear (Ursus thibetanus) and sun bear (Helarctos malayanus).

In brief, iDNA survey techniques isolate traces of target species' DNA from the digestive tracts of invertebrates. This study focusses on the development and utilisation of iDNA to monitor bear species using dung flies as a sampling unit. The study developed and tested the genetic primers and probes which underpinned a targeted, qPCR-based iDNA method for monitoring in situ populations of U. arctos, T. ornatus, U. thibetanus and H. malayanus. Furthermore, using U. arctos as a case study, it evaluates the detection probabilities of target bear species using iDNA techniques compared with concurrently collected spoor survey data. We conclude that this cost-effective technique can be used in conjunction with traditional monitoring methods, help reduce bias and increase the reliability of detecting species in the wild.

POSTER SESSIONS

TRANS-BOUNDARY MOVEMENTS OF GRIZZLY BEARS IN DENALI NATIONAL PARK AND PRESERVE, ALASKA

Patricia Owen[1], *Kaija Klauder*[1]

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Trans-boundary movement of wildlife in protected areas is challenging for species that have high consumptive value or the potential for conflict outside that area. Denali National Park and Preserve experiences trans-boundary issues for a number of species including caribou, moose, wolves, and grizzly bears.

Grizzly bears are considered by many park visitors to be a top priority for viewing or experience in the park. Grizzly bears can be hunted and baited on state lands adjacent to the north-eastern portion of the park where visitor experience is concentrated. Limited data exists on how much harvest and other lethal management practices outside the park may affect bears that primarily reside in the park and provide viewing opportunities for visitors. There is also concern that bear baiting as a harvest technique may lead to food-conditioned bears that could pose a threat to both park visitors and local residents.

Over approximately 10 years, 40 grizzly bears were fitted with GPS radio collars within or near the north-eastern boundary of Denali National Park and Preserve. Location data show that movements fell generally into three categories – those bears that never left the park, those that went a short distance or spent a short time out of the park, and those bears that made marked forays in either distance or time outside the park boundary. Although the difference is partly due to the proximity of the bear's home range to the park boundary rather than to differences in behavior, they were analyzed separately as they represent different management scenarios and exposure risks. Distance, duration, seasonal timing, and speed of extra park forays were analyzed by gender. Home range characteristics and implications for home range size are also discussed.

EFFICACY OF AERIAL FORWARD-LOOKING INFRARED SURVEYS FOR DETECTING POLAR BEAR MATERNAL DENS

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Denned polar bears (Ursus maritimus) are invisible under the snow, therefore winter-time petroleum exploration and development activities in northern Alaska have potential to disturb maternal polar bears and their cubs. Previous research determined forward looking infrared (FLIR) imagery could detect many polar bear maternal dens under the snow, but also identified limitations of FLIR imagery. We evaluated the efficacy of FLIR-surveys conducted by oil-field operators from 2004-2016. Aerial FLIR surveys detected 15 of 33 (45%) and missed 18 (55%) of the dens known to be within surveyed areas. While greater adherence to previously recommended protocols may improve FLIR detection rates, the physical characteristics of polar bear maternal dens, increasing frequencies of weather unsuitable for FLIR detections—caused by global warming, and competing false positives are likely to prevent FLIR surveys from detecting maternal dens reliably enough to afford protections consonant with increasing global threats to polar bear welfare.

EVALUATING UNCERTAINTY IN SPATIAL CAPTURE RECAPTURE ESTIMATES WITH A MULTI-SITE, MULTI-YEAR SAMPLING FRAMEWORK: A UTAH BLACK BEAR CASE STUDY

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Abstract: Spatial capture-recapture (SCR) models are powerful analytical tools that have become the standard for estimating abundance and density of wild populations. When sampling populations to implement SCR, the number of unique individuals detected, recaptures, and spatial recaptures can be highly variable and these sample sizes should influence precision and accuracy of parameter estimates. Using a multi-site, multi-year black bear (Ursus americanus) capture-recapture dataset covering a range of sample sizes, we evaluated the uncertainty of SCR structural parameter estimates, specifically density, detection, and the movement parameter sigma. Testing the behavior of SCR models with sparse empirical datasets typical of low-density, wide-ranging species can inform the threshold at which a more integrated modeling approach with additional data sources or additional years of monitoring may be required to achieve reliable parameter estimates. Increasing total detections was most closely associated with decreased uncertainty for density and sigma estimates, while an increasing number of recaptures decreased uncertainty for detection estimates. However, measures of uncertainty were not always indicative of reliable estimates. In one population, the most precise density estimates were unrealistically high, suggesting positive bias. We detected signals of estimate bias when a large proportion of recaptures were of individuals in the same location, constraining sigma estimates and inflating density estimates. Researchers should closely evaluate resulting sample sizes and ratios before implementing SCR to detect signals of bias, as large numbers individuals detected, numbers of spatial recaptures, and precision alone may not be good indicators of parameter estimate reliability.

DEFINING AND MEASURING SUCCESS OF AVERSIVE CONDITIONING AND HAZING PROGRAMS FOR BEARS: A REVIEW

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Human population growth and increasing urbanization are leading to rising human-bear conflict across landscapes where human developments and bear ranges overlap. In many areas, societal tolerance for bears is also increasing, supporting the use of non-lethal techniques for managing human-bear conflict, particularly in threatened populations. Aversive conditioning (hereafter AC) and hazing are behavioural management tools that apply negative stimuli to wild bears with the goal of increasing wariness, decreasing undesired behaviour, and reducing human-caused bear mortality. Although AC and hazing are widely used in North America to mitigate human-bear conflict, there is limited synthesis of the past literature or established metrics with which to design or evaluate the success of these programs. We comprehensively compiled data from 39 research papers on the use of AC and hazing on bears from peer reviewed (n=12) and grey literature sources (n=27). We found that 81% of papers reported success of behavioural management programs with 83% showing short-term reduction of conflict behaviour (within the same season as management) over long-term reduction or cessation of conflict behaviour (17%). Additionally, behavioural management was more likely to be successful when conducted on lower conflict (habituated vs. food conditioned) bears. We present data on biological, behavioural and management factors that correlate with success of AC and hazing programs. We synthesized established measures for evaluating that success, and outline methods to increase efficacy of assessment of future programs. Investigating historical trends in behavioural management of human-bear conflict and identifying rigorous and repeatable measures of success for AC and hazing programs can help set reasonable measurements of success for both existing and new programs, advancing non-lethal management practices throughout ranges where bears and people share space.

INSIGHTS INTO THE SPATIOTEMPORAL DISTRIBUTION OF ARCTIC MARINE MAMMALS FROM POLAR BEAR DIETS

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Climate warming is expected to have widespread effects on habitat conditions and species distribution. However, there is limited information on marine mammal distribution across the Arctic making tracking of range shifts challenging. Monitoring spatial patterns of polar bear (Ursus maritimus) diet may reveal localized areas of prey availability and provide early signals of shifts in prey population distributions. Our objective was to investigate the spatial feeding patterns of polar bears across Nunavut from 2010-2018 (n = 1570) and identify spatiotemporal clusters of different prey based on predator diet estimates. Quantitative fatty acid signature analysis and the Getis-Ord Gi* statistic identified spatial clusters of high or low dietary proportions (i.e., “hot spots” and “cold spots”) reflecting seasonal and spatial availability of prey. Polar bear diet varied within and across Canadian subpopulations and generally matched known patterns of seasonal and spatial prey availability. Ringed seal (Pusa hispida) were the primary prey followed by bearded seal (Erignathus barbatus) with no overlapping spatial clusters, likely because of differing habitat preferences. Year-round hot spots of walrus (Odobenus rosmarus rosmarus), harbour seal (Phoca vitulina), and harp seal (Pagophilus groenlandicus) consumption were linked to known areas of high regional abundance. Year-round beluga whale (Delphinapterus leucas) hot spots were found along eastern Baffin Island and southern Viscount-Melville Sound providing new knowledge of local conditions. Bowhead whale (Balaena mysticetus) hot spots occurred around south-eastern Foxe Basin and seasonally in southern Viscount-Melville Sound suggesting carcasses are locally accessible to bears and may act as a supplemental food source in particular areas and seasons. Congruence between polar bear feeding patterns and known prey distribution indicates accuracy and supports ongoing monitoring of diet to eventually reveal regional and broad-scale changes in prey population distributions. Thus, polar bears can serve as early ecological indicators in a rapidly changing Arctic.

GENERATIONAL IMPACTS OF ECOTOURISM ON THE BEHAVIOR OF BROWN BEARS (URSUS ARCTOS)

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The Glendale River in Knight Inlet, British Columbia, Canada is home to commercial bear viewing activities which have operated under a consistent regulatory framework since 2000 and ongoing behavioral research and monitoring since 1998. As such the site presents an opportunity to assess changes in brown bear behavior at a commercial viewing site on an inter-generational time scale. Initial studies at the site (1998-2001) conducted during a period when bear viewing ecotourism was a new activity in the region and co-existed with hunting, identified temporo-spatial avoidance of viewing activities by adult male bears. While the mechanism driving this is unclear, avoidance of key fishing sites enabled refuging behavior in females with cubs and allowed increased fishing effort through reduced vigilance in this age-sex class.

During the 2018 and 2019 salmon seasons the initial studies were replicated to assess changes in behavior which may have occurred under a stable management regime, whereby resident bears have experienced viewing throughout their lifetimes.

Preliminary results indicated that adult male bears approached key fishing sites at different time periods to subordinate age-sex classes; males were active more than would be expected based on their proportion in the observed population, while in 1999-2001 they were less likely to be seen during viewing, whereas subordinate age/sex classes were less active across all times. This suggests that adult male bears have shifted their behaviour to tolerate humans to access the salmon stream under consistent human activity and there is no longer evidence of temporal refuging for subordinate age/sex classes. Variation in bear behaviour during viewed and non-viewed sessions was observed with bears displaying increased locomotion, increased social behaviour, decreased foraging, and decreased ‘other/unobservable’ behaviours under viewed conditions. Although bears were present during both viewed and non-viewed sessions, they display changes in behaviour when being viewed (reduced foraging) which could indicate disturbance. This has implications for the long-term management of viewing sites and for our understanding of risk avoidance.

HABITAT SUITABILITY MODELS AND CLIMATE CHANGE: PROJECTING HABITAT CHANGES FOR THE POLAR BEARS OF DAVIS STRAIT

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Habitat selection models allow researchers to predict where a species may occur based on their presence or absence within specific environmental variables, and they can be useful in understanding the ideal habitat of vulnerable species. For predators, however, their spatial ecology is influenced by the presence or absence of prey. Yet models that incorporate predator-prey interactions are uncommon in ecology. Creating habitat suitability models that incorporate both prey and the potential impacts of environmental change on their habitat, will help us better conserve their habitats and ensure their continued survival.

The overall goal of this study is to understand how climate change might affect the suitable habitat of one of the most under-researched subpopulations of polar bears (Ursus maritimus), the Davis Strait (DS) subpopulation, located in northeastern Canada (between Labrador and Greenland). Our objectives are to: 1) assess trends in sea ice dynamics from 1979-2020; 2) calculate home range sizes for polar bears using telemetry data (from 28 female bears between 1991-2001) and various home range estimators; 3) examine seasonal habitat selection patterns for polar bears using statistical modelling (e.g., by developing resource selection functions); 4) determine the overlap in habitat use for polar bears and Northwest Atlantic harp seals (Pagophilus groenlandicus), one of their primary prey, using telemetry data (from 41 seals between 1993-2005), resource selection functions, and other modelling techniques (e.g., using latent significant difference functions); and 5) use projected sea ice models to estimate how this overlapping habitat might change in the future due to climate warming. Our results indicate that the length of the ice-free season in DS is increasing by 10.9 days/decade and research shows that a longer ice-free season may have resulted in decreased body conditions, survivability, and reproduction rates in other subpopulations. Mean home range sizes for female bears in DS range between 66,000-137,000 km2, depending on the metric used. Habitat selection also varies between season, with the best models indicating that selected habitat covariates include ocean depth and ice concentration in freeze-up, distances to land and open water in winter, and ocean depth and distance to land in the break-up. Finally, the overlap in home ranges between the two species also varies between seasons. DS polar bears and harp seal home ranges overlap in freeze-up, break-up, and the ice-free season, but not in the winter months. Our next steps include comparing seasonal selection patterns between the two species and assessing how overlapping habitat might be affected in the future due to various climate emissions scenarios. This will allow us to understand not only where the suitable habitat of DS polar bears may shift to in the future, but also whether or not the habitat of their primary prey will exist in the same space.

PRESENCE OF ANDEAN BEAR (TREMARCTOS ORNATUS) IN MINING CONCESSIONS SOUTH OF ECUADOR

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In Ecuador, Andean bears are present in 14 provinces along highlands and foothills forests located north to south of the country. Only 35% of its habitat is “permanently” protected because it is within the national system of protected areas, the remaining is privately owned, and partially protected. In the country the species is classified as endangered.

Metallic mining in Ecuador has grown substantially in the last 10 years, representing 1.25% of the gross national product in 2017 with a projection of more than 4% in 2021. There are some metallic mining concessions which occur in the Andean region overlapping with bear habitat.

In 2016, in a mining concession in the south of Ecuador, owned by Aurelian Ecuador, a subsidiary of Lundin Gold Inc., the presence of Andean bears was reported through direct observations. In the same year, through the monitoring with camera traps, nine bears representing different life stages were recorded.

These first results motivated the development of a deeper and more complex monitoring program including complementary studies to determine: presence, density, genetic variability and telemetry, both in the original concession, which was surveyed before, and in a new nearby concession. So far, more than 15 bears have been recorded in the area and some of their movements have been inferred. Together, other interesting results are generating discussions, such as the interactions of bears with other big mammals, or their adaptation to the presence of people and mining activities.

Experiences from the past have created a negative perception of mining with respect to environmental and species conservation. However, through these programs, results will provide scientific information about the ecology of the Andean bear in a territory where there is no available data for the species. According to the national conservation plan, this territory is important for the Andean bear population conservation and this research will be available when strategies and conservation decisions about the Andean bear in the territory will be considered in the future.

GRIZZLY BEAR DEPREDATION ON GRAZING ALLOTMENTS IN THE GREATER YELLOWSTONE ECOSYSTEM

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Grizzly bear population growth and range expansion in the Greater Yellowstone Ecosystem (GYE) during the last several decades has led to increased grizzly bear-human conflicts, including livestock depredation on public land grazing allotments. Reducing such conflicts and improving conservation efficacy requires information on the relationships between livestock depredations, allotment management, and grizzly bear habitat conditions. We used generalized linear mixed models to evaluate spatio-temporal relationships between grizzly bear depredation of livestock and the characteristics of 316 USDA Forest Service and National Park Service grazing allotments in the GYE during 1992–2014. During the study period, more grazing allotments became occupied by grizzly bears and most livestock depredations were associated with these areas of population expansion. Allotment livestock numbers and grizzly bear density index had the greatest positive association with the number of livestock depredation events relative to other allotment characteristics measured. Estimated number of depredation events on allotments increased by approximately 20% when cow-calf pairs increased by 100 pairs and when grizzly bear density index increased by 5 bears per ~1,000 km2. Additionally, larger grazing allotments with fewer bull cattle or horses, lower road densities, less rugged terrain, higher vegetative primary productivity, and more whitebark pine coverage were associated with more livestock depredation events. As the grizzly bear population continues to expand, natural resource managers and livestock producers could focus efforts on allotments with characteristics we found to be associated with higher frequency of depredation when developing cooperative management plans and preventative measures to reduce the likelihood of livestock-bear conflicts. The perspectives gained from our analysis provide important context for long-term, landscape-level planning to accommodate livestock production on public lands while meeting conservation objectives for grizzly bears.

POLAR BEAR DENNING DISTRIBUTION IN THE CANADIAN ARCTIC

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Climate change has led to declines in Arctic sea ice, resulting in habitat loss for ice-adapted species, while facilitating increased development at higher latitudes. Development brings economic growth to northern communities, but also increases land use and shipping traffic which can pose a threat to ecologically and culturally important species. Although studies have assessed the climate-related consequences of spring and summer sea ice habitat loss to polar bears (Ursus maritimus), less research has focused on winter habitat such as maternity denning areas. Female polar bears and cubs are susceptible to disturbance during denning and a better understanding of the distribution of denning habitat may aid effective management. We compiled existing data on polar bear denning (n = 64 sources) in Canada between 1967 and 2019. These include traditional ecological knowledge (TEK) studies, government and consultant reports, peer-reviewed scientific articles, and unpublished data acquired through data-sharing agreements with local jurisdictions. We synthesized these data to create a map of known denning locations. We found most coastal regions in northern Canada supported denning, but large areas exist where denning is unreported. Gaps remain in the knowledge of polar bear denning in Canada: filling these gaps will aid the conservation and co-management of polar bears.

INITIAL DENSITY ESTIMATES OF AMERICAN BLACK BEAR (URSUS AMERICANUS) IN ESTABLISHED AND EXPANDING PARTS OF THEIR RANGE IN MASSACHUSETTS, USA

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In many parts of North America, black bears (Ursus americanus) are recolonizing areas from which they were extirpated during colonial settlement. Densities in well-established and expanding parts of black bear range can vary, as can levels of human development, and potential for human-bear conflict. Identifying and predicting these differences are essential for effective black bear management and conservation. We conducted a spatially-explicit mark-recapture study of black bears in the Commonwealth of Massachusetts with two sampling arrays; one west of the Connecticut River (established range) and one east of the river (expanding range). We hypothesized that densities in the expanding range would be less than those in the established range. In total, we deployed 122 hair snares covering ~1,700 km2. The snares were checked weekly over a 9-week summer sampling period in 2019. We genotyped black bear samples at 8 microsatellite loci, identified individual bears, and generated capture histories. We used the capture histories to estimate black bear density in the two grid arrays as a function of multiple geospatial covariates such as land cover variables, human development variables, and landscape metrics. We examined differences among our two sampling arrays and used our models to predict density and abundance across known black bear range in Massachusetts. Our results are the first density estimates for black bears in Massachusetts since 1993 and will be used to inform black bear management and conservation in the state. Additionally, we used harvest, nuisance, and vehicle collision data to examine population dynamic trends and varying interactions with anthropogenic features across the state."

DYNAMIC OCCUPANCY MODELS REVEAL THE IMPACT OF HUMAN RECREATION ON BLACK BEAR ACTIVITY PATTERNS

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While protected areas encompass ~15% of Earth's terrestrial surface and serve an important role in wildlife conservation, the majority of wildlife occur outside protected areas and are subject to varying degrees of human disturbance. The human footprint (HFP), a global map that provides a striking visualization and index of the magnitude of human influence across Earth's land surface, is a powerful tool to help inform our understanding of species' distributions and abundances relative to human-induced landscape change. However, the impacts of human activities on wildlife populations extend beyond physical changes of Earth's land surface indexed by the HFP to include actual human presence (AHP), which is less spatially and temporally predictable than the HFP. Evidence suggests that AHP can influence wildlife behavior by disrupting movement, forcing changes in diel activity patterns, and mediating predator-prey interactions. Thus, using the American black bear (Ursus americanus) as an ecological model, our goals are to (a) determine whether HFP or AHP better predicts black bear spatial and temporal activity patterns and (b) discern whether different types of human recreation activities evoke distinct responses in black bears. To achieve our goals, we deployed 30 trail cameras across a 60 km² study area that includes multi-use lands managed by MI-Department of Natural Resources, The Nature Conservancy and Hancock Timber Management Group in Marquette County, Michigan. Preliminary results suggest that HFP and AHP both provide novel information for understanding black bear spatial and temporal activity patterns and that varying human activities result in distinguishable shifts in black bear activity patterns. Though analyses are ongoing, understanding how black bears and other species of management concern respond to both static (HFP) and dynamic (AHP) human disturbances across the landscape is critical for identifying opportunities to minimize the negative effects of human activity on wildlife communities.

A CITIZEN SCIENCE APPROACH FOR STUDYING BERRY PHENOLOGY

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Berries are a key component of many bear diets across the world and can influence bear fat levels, which has effects on reproduction and survival. However, berry phenology and productivity is understudied. We share our citizen science approach to data collection, using Survey123, which allows integration with a real-time web app showing phenological development as people upload data. We also share an assessment conducted to evaluate best practices for berry phenology data collection, particularly when the focal species is small or otherwise hard to observe. We compared the presence of phenological stages and the counts of phenological stages between people with personalized in-depth training (~3 hours) and people with minimal training consisting of only pictures and short instructions introduced immediately prior to a particular new kind of data collection (~5 minutes total). Across phenological stages, we found that counts of stages had high accuracy, especially when few flowers or berries were present, with underestimation and variation increasing at high numbers of flowers and berries. Because this variation is predictable and conforms to known statistical distributions, these kinds of data are highly valuable and can be incorporated in statistical models of phenology. Volunteers also consistently recorded high quality photographs that could frequently be used to assess the presence of phenological stages. We share lessons learned about study designs for citizen science research in contexts with limited training.

DISTRIBUTION AND RANGE OF THE CABINET-YAAK AND SELKIRK MOUNTAINS GRIZZLY BEAR POPULATIONS

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The distribution of the Cabinet-Yaak and Selkirk Mountains grizzly bear population has not been previously mapped, but appears to have expanded in the last 2 decades. We adopt the technique described by Bjornlie et al (2014) in the Yellowstone grizzly bear population to describe and explore current distribution of these two recovery areas and examine connectivity between them using telemetry, mortality, sightings, and genetic samples from 1983-2019. The technique utilizes a grid, zonal analysis, and kriging to estimate distribution. We explore strengths and weaknesses of the technique when applied to a sparse population in two different but geographically close grizzly bear populations.

RESPONSES OF AMERICAN BLACK BEARS TO THE CHIMNEY TOPS FIRE IN GREAT SMOKY MOUNTAINS NATIONAL PARK

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Little is known about how wildfire may affect American black bear (Ursus americanus) ecology in the eastern U.S. On November 23, 2016, wildfire was reported in the Chimney Tops region of Great Smoky Mountains National Park near Gatlinburg, Tennessee. On 28 November, dry fuels coupled with strong winds, with gusts up to 87 mph (140 kph), caused the fire to spread rapidly. Multiple wildfires developed and spread to the city of Gatlinburg with about 72-km2 being burned, including a large area in Great Smoky Mountains National Park. Over 175 human injuries and 14 fatalities occurred, with >2,400 structures damaged or destroyed. Eight bears within the vicinity of the wildfire were equipped with Global Positioning System (GPS) wildlife tracking collars as part of 2 separate studies prior to the fire event. We evaluated space use, movement rates, and mean direction of travel in a before-after-control-impact design to determine how bears reacted to the fire. We found no differences in spatial use (home range size and shifts, movement rates, turning angles, resource selection) between bears that were exposed to fire (treatment, n=8) and not exposed (control, n=12) but some use of burned areas following the fire was documented. All radiocollared bears in the path of the fire survived. Even with a fire this extreme, small areas of low fire severity within the footprint of the fire were associated with mesic, rocky areas with low solar radiation. We suspect that bears made use of those refugia to escape the fire.

HUMAN-PROVISIONED FOODS IMPACT BLACK BEAR GUT MICROBIOMES: IMPLICATIONS FOR MANAGEMENT

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Mammalian microbiomes, the complex communities of microorganisms (e.g., archaea, bacteria, fungi, protozoa, viruses) that inhabit virtually every body site, profoundly affect mammalian behavior, physiology, reproduction, health, survival and ultimately, evolution. The vast majority of mammalian-associated microbiomes are found in the gastrointestinal tract of their hosts (i.e., gut microbiomes [GMBs]) and perform countless micro-ecosystem services, from conferring genetic and enzymatic processes essential for nutrient uptake, energy harvest, digestion and tissue development to facilitating immune responses, and mediating emotional and physical wellbeing. Though many factors such as phylogeny, life stage, and sex shape mammalian gut microbiomes, the structure and function of mammalian GMBs are significantly associated with diet. Thus in a world increasingly dominated by human influence, human-mediated perturbations to wildlife trophic webs have the potential to shift and possibly decouple the tightly co-evolved relationships between mammals and their microbes. We used American black bears (Ursus Americanus) as an ecologically and socially engaging model management species to investigate how provisioning black bears with unprocessed bait (i.e., corn, raw peanuts) during the annual regulated hunt in coastal North Carolina influences black bear gut microbiome community composition and membership. We sampled 48 harvested black bears and used a combination of next-generation sequencing, stable isotope analysis, and bioinformatic analysis to evaluate the relationship between gut microbiomes and diet. Preliminary analyses from a study in Michigan suggest Firmicutes and Proteobacteria are the most dominant phyla in black bear gut microbial communities and that microbial taxonomic diversity decreases with increased consumption of human-provisioned foods. As we assess potential health implications of providing bears access to bait and human foods, we hope our research will serve as a catalyst for future studies as we strive to conserve and effectively manage healthy wild bears and their essential symbiotic gut microbiomes.

INVESTIGATING A NOVEL BIOMARKER FOR MONITORING REPRODUCTION IN POLAR BEARS

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Polar bears (Ursus maritimus) in the wild are under threat due to climate change, pollutants, and habitat disruptions, and experience poor reproductive success in zoos. The polar bear is a seasonally polyestrous species that exhibits embryonic diapause and pseudopregnancy, complicating characterization of reproductive function. Fecal excretion of testosterone and progesterone have been studied extensively in polar bears, but questions remain about their reproductive function. Dehydroepiandrosterone (DHEA) is a steroid hormone precursor that has been correlated with reproductive success in other species, but has not been studied extensively in the polar bear. The purpose of this study is to characterize the longitudinal excretion of the sulfated form of DHEA, DHEAS, from zoo-housed polar bear feces using Arbor Assay® enzyme immunoassay kits. Lyophilized fecal samples from parturient females (n = 10), breeding non-parturient females (n = 11), a non-breeding adult female, and a juvenile female were tested according to the EIA kit's protocols. DHEAS concentrations were closely associated with testosterone concentrations ($p < 0.05$). Breeding females exhibited statistically significant ($p < 0.05$) increases in DHEAS concentration on or near breeding dates, which were not observed outside of the breeding season or in non-breeding animals. Breeding non-parturient females exhibited significantly ($p < 0.05$) higher mean DHEAS concentrations than parturient females. These findings suggest that DHEA is related to estrus or ovulation in the polar bear, and that there is an optimal DHEA concentration window, and concentrations exceeding that threshold may result in reproductive dysfunction. With rapid changes occurring in the arctic, it is imperative that researchers have multiple tools available, including endocrine assays, to better understand polar bear reproductive function to facilitate the long-term survival of the species in both managed and wild settings.

MOVEMENT AND HABITAT SELECTION OF URBAN BLACK BEARS IN THE WEKIVA RIVER BASIN IN CENTRAL FLORIDA, USA

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Florida black bears (Ursus americanus floridanus) in the Wekiva River Basin in central Florida reside in an area where protected conservation lands abut high densities of anthropogenic development, both residential and commercial. Not only has the local human population grown drastically, resulting in habitat loss and increased human presence, but the bear population has also grown over the past decade along with the number of human-bear conflicts. Therefore, we sought to investigate the movements and habitat selection by bears in this urban area. Between 2014 and 2016, we captured and GPS collared 17 bears (9 females, 8 males), resulting in 68204 hourly bear-locations. We performed an Integrated Step Selection Analysis (iSSA); for each bear, we matched each used step with 15 unused steps. We fit an exponential distribution and Von Mises distribution to the used step lengths turning angles, respectively, and drew 15 random unused steps from these distributions to match with each used step. We ran conditional logistic regression with covariates of step length and cosine of turning angle, as well as their interaction with the landcover at the start of the step to test for differences in movement by land cover type. We also tested for habitat selection in the model by including covariates of land cover at the end of the step and its interaction with season and hour. We found that bears tended to select for natural land cover types in the dawn and daylight hours but were more likely to select for rural and urban land cover types in hour during dusk or night. Our results provide useful information for bear management and conflict mitigation in this urban area.

AMERICAN RESIDENTS' KNOWLEDGE OF BROWN BEAR SAFETY AND APPROPRIATE HUMAN BEHAVIOR

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The popularity of viewing wildlife, specifically brown bears (Ursus arctos), is increasing rapidly throughout North America. In addition, population distributions of both humans and brown bears are expanding, creating larger areas of overlap and increased possibility of human–bear interactions. Unfortunately, many who encounter brown bears may have never received any form of bear safety training or education. As a result, it is important for wildlife and park managers to understand the general level of bear safety knowledge and identify potential areas of improvement. To do so, this study employed a quantitative self-assessment questionnaire, distributed online to a representative sample of the American public in October of 2019. The questionnaires asked respondents about their experience viewing bears and then asked them to rate the likelihood of performing several actions as well as the perceived appropriateness of each behavior for 12 different bear viewing scenarios. Of 511 complete responses, 40% reported seeing a wild brown bear, but the majority struggled to identify brown versus American black bears (U. americanus) in photographs, suggesting species-specific behavioral recommendations may be ineffective. Further, several factors were significant predictors of an individual's perceived appropriateness of the listed human behaviors, including age, gender identity, source of bear safety information, and experience with bears. Results were then used to develop a set of meaningful recommendations to improve the efficacy of current bear management and safety education. Primary recommendations include the following: 1) Increase the focus on appropriate rather than inappropriate behaviors, explaining the reasoning behind such suggestions; 2) Pay special attention to overly confident individuals or those with more experience; and 3) Use photographs, videos, and virtual reality experiences to better prepare visitors for a range of potential encounter scenarios.

A PILOT STUDY OF METHODOLOGY TO DETERMINE BEAR HAIR GROWTH RATES FOR CONSERVATION AND MANAGEMENT

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Foraging ecology of wildlife populations has important implications for individual health, population productivity, and distribution patterns. In bears, food resources and foraging behavior primarily affect population dynamics via effects on cub production and survival. Much of what is known about the feeding ecology of bears is based on analysis of various tissues collected from capture-based research efforts, harvested animals, or non-invasive approaches. However, inference about diet from hair has been limited by a lack of quantitative data on the timing of the molt and hair growth rates. We conducted a pilot study to design methods to quantify hair growth rates in two species of bears (n= 1 polar bear, n= 4 black bears) through a collaboration with zoos. We identified and implemented an effective visual and biochemical approach proven safe for humans and other animals to quantify the rate and timing of hair growth. The pilot study included a) feeding an isotopically-labeled ingestible glycine (amino acid) capsule that 'marks' time at a particular location as it is incorporated within the hair and, b) the application of a small patch of hair dye on the rump or leg. Fur dye qualitatively determined if and when new hair is growing, and the glycine marker quantified hair growth between the time the marker is fed and the time that hair is collected. We collected hair at regular intervals (every 1-2 weeks) for five months from locations on the bear consistent with commonly sampled collection points in wild-caught bears. Hair samples were used to determine the timing of incoming new hairs, preliminary growth rates, and the incorporation and circulation times of glycine. The future goal of this project is to provide a foundation for incorporating seasonality in the wild-collected hair samples by assessing growth over an annual cycle.

GPS DATA QUALITY AND ITS EFFECT ON HABITAT USE MODELING

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GPS fix success and data quality are important factors to consider when modeling habitat use by black bears. Habitat, animal behavior, GPS hardware, and visible satellites can all influence fix success rates and the quality of data collected (2D vs 3D). If we don't account for all of these issues we are potentially biasing our animal-habitat use models. Here we present how to QAQC GPS collar data sets, calculate proper fix success rates, and discuss the pitfalls associated with using poor quality GPS data to model resource selection for black bears.

MALE AMERICAN BLACK BEAR (URSUS AMERICANUS) USE OLFACTORY SENSES TO DETERMINE IF A FEMALE BEAR IS OVULATING.

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Chemical communication has a major role in bear reproductive success. The goal of this study is to determine if male American black bears (Ursus americanus) can detect ovulation in females through olfactory investigation of urine. By determining ovulation, males can time the mount so that there is a greater chance of fertilizing an egg. Past studies from our lab have indicated that males preferred to mount females with maximal vulvar swelling, and those males that were able to mount first successfully fathered cubs. Currently, we are performing research where males are presented with urine that represents four different stages in the estrous cycle (anestrus, early proestrus, late proestrus, and peri-ovulatory). Scent preference trials will be used to measure the time spent investigating each stage. The data will be recorded continuously for 20 minutes using one focal animal at a time. It is predicted that males will spend more time investigating urine from the peri-ovulatory stage than the other stages. Also, there will be an increasing trend of investigation in the female's urine the closer she approaches to ovulation. If this is true, males would have greater reproductive success, because they will spend less time with females that do not have eggs ready to fertilize. This research will be one of the first to measure the American black bears' ability to detect a female that is in estrus, and further the research that bears can discriminate between females to find one that is likely to conceive at the time of coitus.

VARIATION IN BROWN BEAR GUT MICROBIOMES: IMPLICATIONS FOR CONSERVATION AND MANAGEMENT

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Gut microbiomes (GMBs), the complex communities of microorganisms inhabiting the gastrointestinal tracts of their hosts, perform countless micro-ecosystem services such as facilitating energy uptake, modulating immune responses, and triggering tissue development. While scientists increasingly recognize the important role GMBs play in host health based on studies of model organisms (e.g., lab rodents, non-human primates, humans), the roles of GMBs in mammalian evolution, ecology and conservation have yet to be realized fully. Using brown bears (Ursus arctos) as an ecologically exciting and socially engaging model, our aims are to a) assess variation in brown bear GMBs within and across three protected areas in Alaska, b) evaluate the role that diet (e.g., % salmon in the diet) plays in shaping brown bear GMBs, and c) examine whether intrinsic (e.g., sex, physiological condition) or extrinsic (e.g., geographic location) factors better explain variation in brown bear GMBs. To achieve these aims, we subsampled brown bear fecal samples collected during previous United States National Park Service research activities at Lake Clark National Park and Preserve, Gates of the Arctic National Park and Preserve, and Katmai National Park and Preserve. We recorded individual brown bear physiological data (e.g., sex, age, lean body mass, % body fat), diet data (e.g., stable isotope data) and environmental data (e.g., location, elevation) for all fecal samples. From these samples, we extracted microbial DNA for 16S rRNA amplicon sequencing and bioinformatic analysis to identify factors driving variation in brown bear GMBs. By integrating macro and micro-ecological perspectives, we hope to identify characteristics of brown bear- associated GMBs that can serve as biomarkers for population-level health, which in turn can be used to inform local and landscape-level management decisions to promote long-term brown bear conservation and management.

CARNIVORE CONTRIBUTIONS TO THE CARBON CYCLE

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Carnivore's provide significant dispersal services for plant species that have evolved an endozoochoric seed dispersal syndrome. Multiple differences between carnivores and other frugivorous seed dispersers make their contribution of particular interest. Carnivore's disperse seeds into different habitats and different distances than other frugivores, generally without diminishing seed viability. Carnivores are also experiencing range expansion and repatriation of historic ranges, particularly bears in North America, increasing or reestablishing seed the seed dispersal services that they provide. With this increase in seed dispersal, there is a potential contribution the assisted migration to track favorable habitats in the face of climate change as well as providing for invasion or encroachment of woody vegetation into grasslands and other shifts in plant communities. The range shifts or expansions that are possible from carnivore mediated seed dispersal will, in turn, affect the carbon storage capacity of the affected landscapes. Assisted migration for range shifts necessary to survive climate change will conserve the carbon storage capacity of plant populations that may have otherwise reduced in biomass or gone completely extinct. Dispersal services facilitating plant community conversion to woodier vegetation with larger physical structures can increase a given landscape's carbon storage capacity.

SPATIALLY EXPLICIT POPULATION ESTIMATES AT A REGIONAL SCALE: THE SOUTHERN APPALACHIAN COOPERATIVE BLACK BEAR STUDY

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Spatially explicit capture-recapture (SCR) has gained traction in recent years as an effective large-scale population estimation method. The use of SCR in combination with a clustered sampling design and passive trapping methods have allowed researchers to cut costs while providing empirically derived estimates of population density of elusive and low-density wildlife species at large spatial scales. The economies of scale associated with pooling datasets into larger analyses supports collaborative efforts across state and agency lines. We describe a regional population estimate of the American black bear (Ursus americanus americanus) spanning over 66,000 square kilometers of the southern Appalachian Highlands in Georgia, North Carolina, South Carolina, and Tennessee. In 2017 and 2018 we established 888 barbed wire hair sampling sites arranged in clusters of 5, with sites being spaced 2,000 m apart within clusters and 16 km between cluster centers. We collected bear hair from those sites, extracted DNA, and genotyped the data to identify individuals. We performed SCR analysis by creating a categorical session-level covariate of density to evaluate the effect of management and harvest methods that differed among jurisdictions. Moreover, we used 14 land use-land cover-based covariates of density to model inhomogeneous population distribution across space to predict population density in areas not sampled. State and regional estimates of population density and abundance were developed and will be discussed. Our study illustrates how intra-agency collaboration can result in precise population estimates of black bears across jurisdictions and at large spatial scales with reasonable cost.

AMERICAN BLACK BEARS IN MISSOURI: RECOVERY, EXPANSION, AND CHALLENGES

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Successful conservation strategies require sound information on wildlife demographics and spatial distribution in the area of interest. American Black bears (Ursus americanus) have lost more than a third of their historical range, but are currently recovering and expanding in many areas. Specifically in Missouri, USA, black bear reports have steadily increased over the last 25 years, suggesting abundance and distribution is also increasing. We built a stage-based matrix and population model using 10 years of field-collected demographic and movement data, and implemented the stage matrix into a spatially explicit metapopulation model to quantify and predict the growth and expansion of the black bear population in Missouri. The initial bear population for the model was developed based on a local capture-recapture study from 2012, and the landscape suitability on a previously developed distribution model using telemetry data (2010–2018). We collected reproductive data (2011-2020) which induced 147 female bears monitored, 70 litters, and 139 cubs born. Average litter size was 1.99, with 42% of cubs being female. We delineated 53 core habitat patches covering about 14,000 km2. In 2021, the bear population is estimated to have colonized 27 to 43 of the 53 available core patches. The estimated carrying capacity (excluding cubs of the year and considering only core patches) was 2700 bears. The population within core patches 2021 was estimated at 600-880 (5th—95th percentiles), which corresponds to about 27% of the core carrying capacity, with most bears occupying the southern portions of the state. Future conservation and management of bears in Missouri will benefit from preserving these well-connected high-quality habitat patches, while targeting conflict mitigation strategies in areas with anticipated increases in bear abundance and human-bear interactions.

HAEMATOLOGY AND SERUM BIOCHEMISTRY PARAMETERS OF THE BROWN BEAR FROM SERBIA

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Haematology and serum-biochemistry parameters were determined for wild-living brown bears from Dinaric-Pindos population from Serbia. Blood sampling is included in the standard procedure during trapping and collaring of brown bears. Before sampling, all bears were chemically immobilized by using medetomidine (20-30 µg/kg) and zolazepam and tiletamine (5-10 mg/kg). Blood samples via cephalic vein were collected from 25 brown bears. The analyses included 12 haematological and 11 serum-biochemical parameters, as well as comparison between sex and age classes (males and females, adults and juveniles). Because of limited sample size, the differences between age classes were tested only for haematology. Differences between sex and age classes were tested using Student's t-test. Basic statistics were also performed for all analyzed parameters. In comparison between sexes, the majority of blood parameters have shown no significant differences. Significantly higher values in males than in females were shown only for calcium ($t=3.293$; $p>0.004$). In contrast to sexes, significant differences were recorded between juvenile and adult brown bears regarding the majority of haematology parameters (leucocytes, thrombocytes, hemoglobin, hematocrit, neutrophil granulocytes, lymphocytes, MCV and MCH). It is necessary to collect a greater amount of knowledge about haematology and serum biochemistry parameters in order to perform successful health screening and health monitoring of brown bear populations.
Keywords: haematology, serum biochemistry, brown bear, Srbia

GRADING FECAL CONSISTENCY IN BROWN BEARS (URSUS ARCTOS): BEYOND LINEAR SCALING

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The consistency of feces of mammals provides an overall impression of gastrointestinal health and digestion. Grading fecal consistency is a non-invasive tool that has been used to monitor the health status of carnivores, especially domesticated species. Several scales are available to grade fecal consistency in domestic carnivores. The same scales have been extrapolated and applied to wild carnivore species, which may not be satisfying for omnivorous species of the Carnivora, such as the brown bear.

Here we aim to develop a fecal consistency scale for brown bears. The consistency scale was developed during a diet study including 9 captive brown bears fed a variety of diets (beef, rabbit, fruits, grass-fruit-pellet mix) in an incomplete cross over design. All feces collected during the adaptation and experimental periods were photographed. Feces from the experimental period were further graded by ‘handling the feces’ and visual inspection of the dietary components. Based on a total of 704 feces, a 6-point scale for uniform fecal consistency was established, with score 1 representing very dry, firm and score 6 representing runny, liquid feces. Two consistencies (“dual consistency”) within a given feces occurred in 12% of all observations, a feature that also occurs in other carnivore species. We therefore added an additional grading system for dual consistency.

The fecal consistency of brown bears is heavily dependent on the dietary items processed prior to defecation: more vegetation (grass) or whole prey (bones and hair) lead to firmer feces. It seems that at certain proportions of the latter, there is a higher chance for dual fecal consistencies. In bears, diet may have an overriding effect on fecal consistency, making judgements on animal health difficult without knowledge of the diet.

BROWN BEAR DAMAGES TO APIARIES IN THE CANTABRIAN MOUNTAINS (SPAIN): THE ROLE OF VARIATION IN NATURAL AND ANTHROPOGENIC FOOD RESOURCES AND PREVENTIVE MEASURES

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In recent times, many brown bear (Ursus arctos) populations are increasing in Europe. This is resulting in bears expanding into highly humanized environments and increasingly frequent conflicts, mainly related to damage caused to human properties. To reduce these conflicts, it is necessary to improve the knowledge about the factors that cause damage. We investigated bear damage to apiaries in an area with high density of bears and also peripheral distribution in the Cantabrian brown bear population (Spain), where the association of damage events with factors that may predispose bears to cause damages has rarely been assessed. A total of 526 damaged (totalling 1,933 beehives) were reported during 2015-2018 in our study area which represents approximately 27% of the damages of the entire Cantabrian Mountains. These damages were distributed in 49 municipalities (5,947.4 km2) where 1,150 apiaries are registered with over 22 thousand beehives. We included in our analysis variables related with the inter-annual variation in spatial distribution of bears and damages, the availability of apiaries, the effort implemented in measures to prevent damage to apiaries and the availability of natural food resources as factors that may influence the occurrence and intensity of damages in each municipality. The probability of bear damage was positively related to the abundance of bears and the availability of apiaries, and the damage intensity (i.e., the number of damaged apiaries in a municipality) was negatively related to the number of preventive measures implemented in the municipality and the availability of natural foods. Moreover, the damage intensity increased with the distance to the bear core areas; i.e., was relatively higher in the peripheral areas of the bear distribution. We discuss the importance of habitat quality, the marginal distribution of young bears, the availability of natural foods and the appropriate management of apiaries in the results obtained.

BROWN BEARS AGREGATIONS DURING MATING IN THE CANTABRIAN MOUNTAINS (SPAIN)

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Bears are described as one of the most solitary species of large carnivore, except for family groups of females with cubs and brief male-female associations during the mating season. When the scientific literature refers to bear courtship, usually regards to the interaction of pairs of bears (male-female), which can last from a few hours to some days. But there are very few cases in which the participation of more individuals is mentioned.

In this study we describe social behavior of brown bears in the Cantabrian mountains (Spain) during mating season. For this purpose, we used own observations to describe 62 cases of mating obtained between 1993 and 2019. In most cases only one male and one female were observed (n=48), but in 14 of the cases (22.6%) there were more than two adult bears observed simultaneously, with a maximum of 6 bears. And in 4 of these cases at least two adult bears of each sex were detected at the same time. We used videos of 22 of these observations, recorded since 2010, to describe in detail bear behavior, and specifically interactions. Several behavioral categories were recorded: walking, foraging, venting, attention, flight, agonistic interactions, copulation, breast feeding, grooming and play. It is important to emphasize in terms of behavior the performance of agonistic interactions between individuals of the same and different age and sex classes, rare interactions during other bear aggregations.

We must continue studying social interactions that occur among brown bears due to the lack of knowledge on this subject. And highlight the importance that detecting groupings of bears at critical times and in specific areas (mating areas) described in the Cantabrian Mountain in previous studies, in a critically endangered bear population, can have for its conservation.

GOURMET BEARS: SELECTION OF VARIETIES OF FRUIT TREES BY THE BROWN BEAR AND ITS ROLE AS SEED DISPERSANT

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The Cantabrian brown bear population, confined in the Cantabrian mountains of northwestern Spain, is a small and threatened population (300-350 individuals), and isolated from other populations over 300 km. Like other southern subpopulations, these bears are elusive and have a markedly vegetarian diet, including fruit trees, often grown by humans. In this area, most of the damage to goods or human activities occurs, in addition to beehives, to fruit trees, particularly cherry trees and apple trees. In this work we study at the genetic level by microsatellites (simple sequence repeats, SSR) if there are varieties or cultivars of cherry trees that are positively selected by the brown bear. Secondly, we analyze the characteristics of damaged trees comparing with domestic trees feral in forests, with and without damage by brown bear. The SSR allele composition for all plant material (n = 195 trees) was determined by comparison of the allele size. The use of these molecular methods are very useful in this respect since they are codominant, highly polymorphic, abundant and reliably reproducible, which allowed us to differentiate two main molecular clusters. Analyzes carried out comparing the characteristics of damaged and undamaged trees showed that brown bears generally selected cultivated and accessible size trees, with a smaller effect of genetic cluster. On the other hand, the probability of belonging to one of the two molecular clusters showed a certain effect on this selection. Our results suggest that Cantabrian brown bears select trees based more on characteristics that may have an effect on fruit production and quality, but also on specific genetic characteristics. They have direct applications of human-bear conflict management, opening the way to identify those varieties of fruit trees with the highest risk of suffering attacks and that can be substituted for others less palatable to the brown bear, as well as to elucidate the possible role of the brown bear in the dispersal of seeds, in particular of domestic species, a largely unknown aspect in the highly studied biology of the species.

DOCUMENTATION OF TERMITE SPECIES FROM SLOTH BEAR DIET

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Termites are social insects of the order Blattodea and suborder Isoptera that are known to constitute a major part of sloth bear diet. Previous studies have reported termites to be most frequent item, most abundant animal matter in sloth bear diet and a year round staple. However, there are no studies that have aimed to explore the number and diversity of termite species in sloth bear diet. The knowledge of the species that form a part of sloth bear diet can help towards understanding several leading questions about their resource use and distribution. We carried out an exploratory study to identify termite species from sloth bear scat. We used scat samples that were originally collected for another study that was carried out in central India. The scat samples used for this study were collected from 7 different forest areas. It is known that certain termite species are specialists in terms of soil type they are found in while others are generalists. The 6 protected areas and one forest division in our study differ greatly in terms of their soil composition. We therefore hypothesize that termite species occurrence and their diversity in sloth bear scat can differ due to abiotic factors. Out of 205 samples screened, 142 had presence of termites. The undigested termite parts (mostly heads) were separated out for morphometric identification. Overall, we found 15 termite species belonging to 7 genera. Their frequency in samples from different areas differed, which in turn could be due to the difference in their occurrence in these areas. Our study provides baseline information which when coupled with more elaborate research, could shed light on sloth bear resource dependence, foraging patterns and preferences.

RADIOCAESIUM IN A BROWN BEAR POPULATION FROM THE CROATIAN DINARIDES: ACTIVITY CONCENTRATIONS IN MUSCLE TISSUE AND TRANSFER FROM FOREST SOIL TO ORGANISM

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Radiocaesium (137Cs) is a fission radionuclide that can easily bioaccumulate on all trophic levels due to its physicochemical properties and relatively long half-life. It is especially efficiently trapped by forest ecosystems where it can persist for a long time. Therefore, the detection of significantly higher contents of 137Cs in game animals, in comparison to domestic ones, is not uncommon. However, very few studies have been conducted on the presence of 137Cs in bears. This study determined the content of 137Cs in a brown bear (Ursus arctos) population that inhabit the area of the Croatian Dinaric mountains. Activity concentrations of 137Cs were determined by gamma spectrometry in the muscle tissue of 65 animals collected in the period 2013-2018. The measured activity concentrations ranged from 0.6-33 Bqkg-1 with a mean value of 6 ± 7 Bqkg-1. In comparison with accessible literature from a Swedish brown bear population and Asian black bears (Ursus thibetanus) from the Fukushima Prefecture in Japan, our results are up to two orders of magnitude lower. The results of the comparison could be a reflection of the differences in the atmospheric deposition of 137Cs in habitats of these bear populations following the Chernobyl and Fukushima accidents indicating 137Cs content in forest soil as a prevalent factor for the prediction of bear contamination on the population level.
In order to estimate 137Cs transfer from forest soil to brown bears, concentration ratios (CRs) between 137Cs in bear samples and 137Cs in soil (literature data) were calculated. CRs ranged from 0.01 to 0.89, with a mean value of 0.13 ± 0.16. These CRs were one order of magnitude lower than the generic ones proposed by the International Atomic Energy Agency for omnivorous mammals and the same order of magnitude as the ones for carnivorous mammals.

BLOOD FATTY ACID COMPOSITION IN FREE-RANGING AND CAPTIVE EUROPEAN BROWN BEARS

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The composition and incorporation of fatty acids (FA) in blood cells is the resultant of food intake, metabolism and peripheral utilization. Essential polyunsaturated FA (PUFA), linoleic (LA, C18:2n-6) and linolenic (LNA, C18:3n-3) cannot be synthesized by most mammals therefore have to be ingested. They serve multiple functions, and the balance between dietary n-3 and n-6 PUFA strongly affects cellular functions. Eicosapentaenoic (EPA, 20:5n-3) docosahexaenoic (DHA, C22:6n-3) and arachidonic acid (AA, C20:4n-6) are known as "conditionally essential". The objective of the study was to analyse the FA composition of erythrocytes and whole blood in free-ranging (Dinara-Pindos and Carpathian populations) and captive brown bears. The study was conducted on 29 animals (16, Croatia; 13, Poland). Total lipids were extracted and the composition of FA methyl esters was determined by gas chromatography. Lipids isolated from the blood of free-ranging Croatian and Polish bears were dominated by saturated FA (SFA, 65.7±14.3% vs. 45.0±4.3%; $p<0.05$). Second in the representation in free-ranging Croatian bears (N=13) were PUFA (20.6±12.3% vs. 23.06±4.36% in Poland; $p>0.05$), while in free-ranging Polish bears (N=10) those were monounsaturated FA (MUFA, 31.9±3.1% vs. 13.6±6.5% in Croatia; $p<0.05$). Lipids isolated from blood of captive bears in both countries (Croatia vs. Poland) were composed as follows: SFA (66.2±6.2% vs. 40.8±2.6%; $p<0.05$), PUFA (16.9±2.2 vs. 31.8±1.3%; $p<0.05$), MUFA (16.9±7.3 vs. 27.3±3.9%; $p>0.05$). Significantly higher percentages of LNA (2.1±1.1 vs. 0.3±0.1%), AA (8.5±8.1 vs. 0.3±0.2%), DHA (1.8±0.9 vs. 0.7±0.5%) and AA/EPA ratio (0.9±0.6 vs. 0.04±0.02) were found in free-ranging Croatian compared to free-ranging Polish bears. Significantly higher LA (14.98±0.78 vs. 4.39±0.99%), EPA/DHA ratio (9.92±2.15 vs. 2.22±0.02%) and n-3 PUFA family (15.41±1.89 vs. 10.18±2.08%) were found in captive bears from Poland compared to those in Croatia. The FA representation, especially of essential FA, can provide an important health assessment, while variation in the diet FA composition may have an influence on some aspects of animal performance.

SEASONAL CHANGES IN DIEL ACTIVITY PATTERN OF BROWN BEARS FOR DIFFERENT AGE-SEX CLASSES

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Since diel activity patterns of brown bears are known as crepuscular, seasonal changes and differences among sex-age classes of the patterns have not been examined quantitatively. We monitored diel activity patterns of brown bears using 97 camera-traps installed in the Akan-Shiranuka region (1690km2) in eastern Hokkaido, Japan, during April and November in 2017. We divided 4,414 capture events in total into 3 sex-age classes, adult male (AM), adult female (AF), and sub-adult (SA) for 4 seasons, spring (Apr. –May), early summer (Jun – Jul.), late summer (Aug. –Sep.) and autumn (Oct. –Nov.). Diel activity patterns of AM and AF were crepuscular or vesperal, while the patterns of SA was diurnal from spring to late summer. All sex-age classes changed activity patterns to nocturnal or vesperal in autumn. Diurnal activity patterns of SA would be caused by the avoidance of other sex-age classes, particularly AM, and would become a cause of increase in encounter with human as one of the most frequent type of the human-bear conflict in Hokkaido. Decrease of activity during daytime and increase during nighttime in autumn would be related with increase of human activity in the study area because it is the hunting season for sika deer in Hokkaido.

HUMAN-BROWN BEAR (URSUS ARCTOS ISABELLINUS) CONFLICT IN THE LAHAUL VALLEY, HIMACHAL PRADESH

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Himalayan brown bear (HBB) is among the poorly studied large carnivore in India as well as in its entire distribution range. The HBB is threatened because of retaliatory kill to reduce conflict in much of its range in Himalaya. We conducted semi-structured questionnaire surveys in the Lahaul Valley, Himachal Pradesh from June 2018 to December 2019 to collect information on HBB conflicts cases. A total 398 respondents from 37 villages were interviewed covering the entire study landscape. About 64.8% respondents reported conflict out of which 31.4% reported crop damage, 6.2% livestock depredations and 28% reported both. The crop damage was maximum during summer (36.68%) than winter (22.36%). Similarly, livestock (21.86%) depredation was also highest during the summer. The major crop depredated includes lettuce (19.85%), apple (16.58%), green pea (7.04%). Majority of the crop damage took place during the night hours (41.46%; 12 am-6 am) and most of these crops in the area where the distance is <500 meters from the forest or brown bear range (31.41%) and located between the elevation ranges from 2700m-3000m (29.90%). Whereas, similar trend was observed in case livestock depredation. Among the livestock depredated majority were sheep and goats mostly depredated in pasture lands while grazing. Only 10% of the total respondent uses a protective measure to reduce the human-brown bear conflict such as electric fences and barbed wire fencing. The local communities are developing antagonistic behavior against the HBB which is a major threat for the survival of the species in the landscape. However, livestock grazing in HBB habitat is found to be a major factor behind livestock depredation. Awareness creation activities among the local communities may result to decrease in HBB human conflict in the study landscape.

HABITAT USE BY BELITTLING SLOTH BEAR IN THE REGION OF MUSHROOMING MINES, INDIA.

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We studied the habitat use by the sloth bear in Nilgiri Range from July 2018 to December 2020. The habitat use of sloth bears was based on direct sightings, a number of den sites, and indirect evidence such as claw marks, footprints, diggings, and the presence of scats. Through intensive surveys and by walking on 100 km along 20 transects, we recorded GPS locations of sloth bear indirect evidence and direct sightings, and a habitat use map of sloth bears was created.

In total, we had 17 direct sightings of sloth bears in different locations, and 31 individuals including adult, sub-adult, and young ones were seen. The sighting of single individuals (53%) was the highest. So far, we have identified 34 den sites, out of which 7 dens were actively used by bears. These dens were in different habitats; The study area comprised of eight broad habitat types viz. Dry deciduous forest, Bamboo forest, Scrub forest, Grasslands, Rocky outcrop, Plantation, mining area, and Agriculture. The data on indirect evidence showed the varying use of these available habitats and land-use categories by sloth bears. Along the transects, there was a total of 188 indirect evidence which included 102 scats, 54 digging signs, 21 claw marks, and 11 pug marks. The sign encounter rate (#/km) of sloth bears based on transects was 1.88. Outside transects, 112 bears indirect evidence was recorded while carrying out intensive surveys. Most of this evidence was found in the Agriculture field (33%), followed by dry deciduous forest (18%), Mining area (12%). Based on direct sighting and indirect evidence, sloth bears were found distributed throughout the study area and they were deferentially using variously available habitats, but interestingly maximum was in the human used landscape. The strategy was suggested for mitigating conflict.

SLOTH BEAR DENNING ON THE DECCAN PLATEAU

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Denning is an important part of sloth bear ecology and very little is known. Sloth bears use two types of dens, resting and maternal. Resting dens are shelters used by both sexes of sloth bears when inactive, generally during daylight hours, as they are largely crepuscular and nocturnal. Maternal dens are shelters used by a female sloth bears to birth and raise cubs. From 2014 to 2018, we conducted surveys to locate both den types within five discrete study areas on and around the Deccan Plateau of Eastern Karnataka, India. All five areas are completely surrounded by farmlands. We successfully located 40 maternal dens and 380 resting dens. We collected physical data on each den and used the data to model resting and maternal dens independently. We used mixed-effects logistic regression models where the response variable was coded as use (den site, 1) or random (0). The list of a priori models included 47 models for maternal (n = 25) and resting (n = 22) den-site selection. We used Akaike's information criterion adjusted for small sample sizes (AICc) and AICc weights (ωi) to rank models and identify a best approximating model (lowest AICc value) for both maternal and resting dens. All dens were comprised of naturally occurring caves or crevices. The maternal dens were found to be significantly closer to the edges of the natural habitat than were the resting dens. We postulate that areas near the border are being chosen for access to resources, namely food and water, and that mothers choose dens even closer to edges due to the constraints and needs of her cubs. This predilection of mother bears to den near habitat edges is a high-risk high-reward venture, as bears may fall victim to anthropogenic risks. This theory is supported by the fact that also in this study resting and maternal dens were found to be further from habitat edges in better-protected areas, suggesting that if resources are prevalent in the habitat bears would rather keep more of a distance from the borders."

MATERNAL HUMAN HABITUATION, BIRTHPLACE, AND SEX AFFECT BROWN BEAR MORTALITY IN THE SHIRETOKO NATIONAL PARK, HOKKAIDO, JAPAN

Michito Shimozuru[1], Yuri Shirane[1], Masami Yamanaka[2], Masanao Nakanishi[2], Tsuyoshi Ishinazaka[2], Shinsuke Kasai[2], Takane Nose[2], Masataka Shirayanagi[2], Mina Jimbo[1], Hifumi Tsuruga[3], Tsutomu Mano[3], Toshio Tsubota[1]

[1] *Hokkaido University*
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Human habituation of bears is becoming a serious problem that generates human–bear conflict, which often results in the removal of bears as nuisances. Human habituation conceivably reduces the fitness of adult female bears by reducing not only their own survival, but also that of their offspring, due to an increased likelihood of human-caused mortality. We aimed to clarify how human habituation of mothers affects the likelihood of human-caused mortality of offspring in brown bears inhabiting Shiretoko National Park, Hokkaido, Japan. By performing a long-term field survey and microsatellite DNA analysis, we estimated the frequency of human-caused mortality (by management killing and hunting) of independent young (aged 1–4 years) born to mothers living in areas with different maternal levels of human habituation and different proximities to areas of human activity. The overall mortality rate was higher in males than in females, and females living in the front portion of the national park, near a town, were more likely to be killed than were those living in a remote area of park; these results reflect male-biased natal dispersal and the natal philopatric nature of females. Surprisingly, more than 70% of males born to highly habituated mothers living around a remote wildlife protection area were killed by humans; this proportion is greater than that for males born to less-habituated mothers living in almost the same area. By contrast, in the front portion of the national park, maternal human habituation did not significantly affect the likelihood of offspring mortality. The current study clarified that interactions among maternal human habituation, birthplace (proximity to town), and sex determine the likelihood of human-caused mortality of brown bears at an early stage of life.

ANNUAL, REGIONAL, AND INTRASPECIFIC VARIATION IN HOKKAIDO BROWN BEAR DIET: INSIGHTS FROM HAIR STABLE ISOTOPE ANALYSIS

Mina Jimbo[1], Yuri Shirane[1], Masami Yamanaka[2], Tsuyoshi Ishinazaka[2], Masanao Nakanishi[2], Takane Nose[2], Yoshihiro Umemura[2], Hiroyuki Uno[3], Mariko Sashika[1], Toshio Tsubota[1], Michito Shimozuru[1]

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Bears roam large territories to obtain food, sometimes resulting in intrusion into human residential areas. Therefore, to develop appropriate bear management strategies, detailed studies of bear feeding ecology in the context of human–bear conflicts caused by food shortage are required. The objectives of this study were to elucidate the feeding ecology of the Hokkaido brown bear (Ursus arctos yesoensis) in the Shiretoko Peninsula, Hokkaido, Japan. The Shiretoko Peninsula is a narrow landform bounded by coastlines and steep mountains, with a high density of Hokkaido brown bears. We collected hair samples from brown bears (n = 360) during 2010–2019, and performed carbon, nitrogen, and sulfur stable isotope analyses. Our previous study indicated that stable isotopes of extended guard hair reflected the spring–summer diet of the previous year. During spring and summer, Hokkaido brown bears consume a varied diet, e.g., herbs, pine nuts, cherries, and pink salmon. However, we predicted that the brown bear diet would be exceptionally diverse during 2010–2019, as the dominant food varied both annually and regionally during this period. We compared hair isotopic values between years and regions to understand dietary variation associated with changes in food availability. We further examined dietary differences between sexes and maturity stages. Since direct observation and satellite tagging data suggest that foraging in alpine or riverine regions tends to differ among sexes and maturity stages, feeding strategy variation was expected to lead to significant differences in hair δ13C, δ15N, and δ34S values. The results of this study will improve our understanding of resource partitioning by Hokkaido brown bears when food resources are limited for high density populations.

EFFECTS OF SEASONAL AND ANNUAL VARIATIONS IN DIET ON THE BODY CONDITION OF HOKKAIDO BROWN BEARS

Yuri Shirane[1], Masami Yamanaka[2], Masanao Nakanishi[2], Tsuyoshi Ishinazaka[2], Mina Jimbo[3], Mariko Sashika[3], Toshio Tsubota[3], Michito Shimozuru[3]

[1] *Hokkaido Research Organization; Hokkaido University*
[2] *Shiretoko Nature Foundation*
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Brown bears inhabiting the Shiretoko Peninsula, eastern Hokkaido, can access food resources in various environments ranging from coastal to alpine regions. However, several thin bears and starved cubs were found during summer 2012 and 2015, suggesting a lack of important foods. To clarify the food items that determine the summer body condition of brown bears, this study investigated the diet and body condition of brown bears from 2012–2018 in a special wildlife protection area in the Shiretoko Peninsula. The analysis of 2,079 bear feces showed monthly variation in most of the seven food categories. Most of the estimated dietary content was derived from high-lipid pine nuts (39.8%) and high-protein salmon (46.1%) in August and September, respectively, and their consumption by bears varied annually. Next, the body condition of 12 adult females was evaluated by calculating the ratio of torso height to torso length using lateral photos. Their body conditions declined from June, with a minimum in late August, and recovered after September, suggesting that bears lost body fat while feeding on plants, overcame malnutrition by eating pine nuts and salmon, and recovered by consuming hard mast and berries. In addition, body condition began to recover earlier in years when consumption of both pine nuts and salmon was high. Furthermore, the recovery was more rapid in solitary females than in females with offspring, suggesting that mother bears have limited opportunities to forage for salmon. Our study revealed that the body condition of brown bears is determined by coastal and subalpine foods, which are unique to the Shiretoko Peninsula. The strategic use of these findings could conserve habitat suitable for brown bear populations and manage human-bear conflict caused by food shortages.

STUDYING A BROWN BEAR IN KAZAKHSTAN FOR THE PURPOSE OF DEVELOPING MEASURES FOR ITS PROTECTION AND RATIONAL USE

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The brown bear inhabiting Kazakhstan is represented by two subspecies: the Tien-Shan brown bear (Ursus arctos isabellinus Horsfield, 1826), it is protected and included in the Red Book of Kazakhstan and the South-Siberian brown bear (Ursus arctos jeniseensis Ognev, 1924), which is the object of hunting.

In Kazakhstan, brown bears are currently distributed only in the mountain forests of the east, southeast and south of the country. Modern habitats of the species vary depending on the presence of plant and animal feed, protective and genetically suitable conditions, as well as on anthropogenic impact.

The need to organize a systematic study of the brown bear within its range in Kazakhstan is long overdue. The last review article on the bear of Central Asia and Kazakhstan was published in 1993 (Zhiryakov, Grachev 1993), however, it is based on materials from the 1970s (Grachev, 1972, Lobachev, 1972). Since then, systematic monitoring studies have not been carried out, except for a preliminary attempt to estimate the current number of bears in Kazakhstan (Kantarbayev et al., 2015).

ECOLOGY AND GENETIC DIVERSITY OF SLOTH BEAR (MELURSUS URSINUS) IN NEPAL

Rajan Prasad Paudel[1], Michito Shimozuru[1], Rabin Kadariya[2], Naresh Subedi[2], Mariko Sashika[1], Toshio Tsubota[1]

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The sloth bear (Melursus ursinus) is globally vulnerable species, endemic to Indian sub-continent. Their population continue to decline primarily due to habitat loss and degradation and have already become extinct from Bangladesh and Bhutan. Genetic diversity is crucial for species to maintain a population that can evolve, adapt and reproduce successfully under changing climate, environment and other disturbance. While considerable success in flagship species conservation has been achieved in Nepal, bear conservation has never been a priority, thus limiting conservation and management decisions. In this context, we aimed to clarify the genetic diversity and structure of sloth bear from Nepal. By collecting scat (N=116) and hair samples (N=11) from field survey and microsatellite DNA analysis, we estimated the genetic diversity and structure of sloth bear population. We genotyped seven microsatellite loci using 127 samples, identifying 43 individuals. We found that the Sloth bear population in Nepal has lower genetic diversity (HE = 0.37) as compared to sloth bear from central India. We did not detect a signature of population substructure among sampling sites suggesting that sloth bears are moving between these study areas. Small home range for sloth bears in Nepal, lack of strong natural barrier, geographic distance and inadequate isolation time might be contributing to our findings. Further microsatellite genotyping with additional polymorphic loci will strengthen our results This first genetic study of sloth bears from Nepal will support future wildlife management decisions to secure core areas of sloth bears and functional forest corridors.

IDENTIFICATION AND ANTIMICROBIAL RESISTANCE OF MICROFLORA COLONIZING BROWN BEARS IN POLISH CARPATHIANS

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Antimicrobial resistance of bacteria is a worldwide problem that also affects wildlife living with resistant bacteria in the environment. The aim of this study was to investigate microflora colonizing wild brown bears. Additionally, antimicrobial sensitivities of isolates were investigated to see if any resistance of bacteria would be found as a consequence of bears coming into contact with e.g. human waste or other anthropogenic pollutants. Thirty-one individuals were live captured and sampled in two core areas inhabited by brown bears in Poland (Bieszczady and Tatra Mountains). Commercial swabs with transport media were used to collect samples from oral cavity, nasal cavity, ear canals left and right, rectum, prepuce and vagina. Bacteria were identified based on colony morphology and microscopical appearance, followed by biochemical tests. Antimicrobial sensitivities of obtained bacteria were tested using disc diffusion method, according to European Committee on Antimicrobial Susceptibility Testing (EUCAST), e.g. Enterobacteriaceae were tested for sensitivity to ampicillin, amoxicillin, amoxicillin clavulanic acid, cephalexin, ceftriaxone, ceftazidime, cefuroxime, ciprofloxacin, enrofloxacin, marbofloxacin, gentamicin, amikacin, doxycycline, meropenem and imipenem. In total, 195 isolates of 19 bacterial species were identified. Most of species (12) belonged to the family Enterobacteriaceae, while six belonged to gram positive genera (Staphylococcus sp, Streptococcus sp., Enterococcus sp.). Most frequently isolated bacteria was E. coli (76 isolates), followed by Enterobacter gergoviae (34 isolates), Pseudomonas aeruginosa (18 isolates) and Klebsiella sp. (11 isolates). Other bacterial species were isolated from less than ten samples each. Their diversity varied among body sites, for example Klebsiella sp. was found in all body sites except prepuce while Pseudomonas aeruginosa was found in all body sites except vagina. There was no difference in abundance of bacteria between the two core areas ($p>0.05$).

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DENNING OF BROWN BEARS IN THE TATRA MTS. (WESTERN CARPATHIANS) - FREQUENT USE OF THE SAME CAVES

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Hibernation of brown bears is a phenomenon of special interest even among non-specialists. Wintering places for these animals are almost mythical. Common ideas about den site selection and construction do not always correspond to reality. This is largely due to the difficulty in finding and studying these objects. At the same time, bear dens need special protection – wintering bears can be easily disturbed which can be dangerous for people and for animals, spatially new-born cubs.

From 2002 to 2020, 64 dens of at least 20 different brown bears were located in the Tatra Mountains, the highest range of the Carpathians. 32 of them were built in natural rock cavities, karst caves in vast majority. Five of these caves where used more than once (up to 5 times). Some of them were used year by year. These caves were used usually by pregnant females and females with cubs.

THE SPATIAL ECOLOGY OF CONFLICTS: UNRAVELLING PATTERNS OF WILDLIFE DAMAGE AT MULTIPLE SCALES

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Human encroachment into natural habitats is typically followed by conflicts derived from wildlife damages to agriculture and livestock. Spatial risk modelling is a useful tool to gain understanding of wildlife damage and mitigate conflicts. Although resource selection is a hierarchical process operating at multiple scales, risk models usually fail to address more than one scale, which can result in the misidentification of the underlying processes. Here, we addressed the multi-scale nature of wildlife damage occurrence by considering ecological and management correlates interacting from household to landscape scales. We studied brown bear (Ursus arctos) damage to apiaries in the North-eastern Carpathians as our model system. Using generalized additive models, we found that brown bear tendency to avoid humans and the habitat preferences of bears and beekeepers determine the risk of bear damage at multiple scales. Damage risk at fine scales increased when the broad landscape context also favoured damages. Furthermore, integrated-scale risk maps resulted in more accurate predictions than single-scale models. Our results suggest that principles of resource selection by animals can be used to understand the occurrence of damages and help mitigate conflicts in a proactive and preventive manner.

MOLECULAR SURVEY OF ANAPLASMA PHAGOCYTOPHILUM, BABESIA MICROTI AND TOXOPLASMA GONDII IN CARPATHIAN AND DINARIC BROWN BEAR POPULATIONS

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Bears need and use large space where they interact with landscape and where they also experience increased exposure to pathogens in the environment. Pathogen dynamics can additionally vary by anthropogenic factors. Documented exposure of bears usually does not mean the disease in tested individuals, although most tick-borne pathogens can cause serious health problems to humans. In Poland, there is a current issue of a constantly growing number of tick-borne infections, i.e., Lyme borreliosis, tick-borne encephalitis, tularemia, Q fever, human granulocytic anaplasmosis and babesiosis. In Croatia, ticks are widely distributed in the bear range, and the most frequently reported tickborne diseases are Lyme borreliosis and tick-borne encephalitis, and, less frequently, anaplasmosis and babesiosis. Additionally, some studies indicate the potential role of ticks in the distribution of Toxoplasma gondii. We used full blood samples of Carpathian and Dinaric brown bears and nested PCR to survey the Anaplasma phagocytophilum, Babesia microti, and T. gondii exposure. Bears had been sampled over a period of 5 years (2015–2019, N=25 individuals, 31 samples) in Poland and 10 years (2009-2018, N=35 individuals, 36 samples) in Croatia. In total, out of 67 samples, 53 were from free-living and 14 from captive bears. Anaplasma phagocytophilum and T. gondii were found only in one tested bear each, and both in Polish free-living adults. Babesia microti was widespread and detected in 28 (87.5%) Polish and in 22 (62.8%) Croatian samples. All Polish and five Croatian captive bears were positive for B. microti. Of 12 bears negative for B. microti from Croatia, three were captive. The positive samples were relatively equally distributed over sex, age classes and throughout bear distribution. Long-term molecular monitoring of large mammals can provide insight into how environmental changes and anthropogenic disturbances are influencing the distribution of ticks and tick-borne pathogens and diseases.

DEN STRUCTURE AND SELECTION OF DENNING HABITAT BY BROWN BEARS IN THE ROMANIAN CARPATHIANS

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The Romanian Carpathian Mountains provide one of the largest areas suitable for brown bear (Ursus arctos) in Europe, but the long history of logging, along with a drastic increase in new recreation opportunities from motorized vehicles, and encroachment from development may affect brown bear denning habitat through disturbance. As such, understanding den-site selection at the landscape and local levels is important for the conservation and sustainable management of the Romanian brown bear population. We used data on 86 den sites collected between 2010 and 2013 in Southeastern Carpathians and developed Resource Selection Functions for second-order (landscape-level) and third-order (local level) den habitat selection, using habitat structure and topographic attributes of den locations. The altitude of dens ranged between 440 and 1,320 m, with a mean slope of 19.7 ± 0.8%. Aspect was evenly distributed between southwest (22.9% of the dens), east (20.5%), south (18.1%), and southeast (15.7%). Dens stabilized by boulders were dominant (68%), and had maximum mean length = 149.2 ± 5.6 cm, width = 109.1 ± 4.8 cm, and height = 113.8 ± 10.5 cm. At both local and the landscape scales, bears selected for steeper slope and percent coverage of mixed (beech–fir–spruce) forest. At the landscape scale, bears also selected dens at higher altitude, and with greater coverage of old forest, and away from urban areas and recent clear-cuts. Our spatial predictions have the potential to inform forest management by identifying areas where disturbance of brown bear denning habitat should be avoided or limited, thus contributing to brown bear management and conservation planning in the Eastern Romanian Carpathians.

REPRODUCTIVE CLASS AND SEASON AFFECT DIEL ACTIVITY PATTERNS OF BROWN BEARS IN SERBIA

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Most animals concentrate their movement into certain hours of the day depending on drivers such as photoperiod, ambient temperature, inter- or intraspecific competition and predation risk. The main activity periods of many mammal species, especially in human dominated landscapes, are commonly set at dusk, dawn and during night time hours. Large carnivores, such as brown bears, often display great flexibility in diel movement patterns throughout their range, and even within populations, striking between individual differences in movement have been demonstrated. Here, we evaluated how seasonality and reproductive class affected diel movement patterns of brown bears of the Dinaric-Pindos and Carpathian bear populations in Serbia. We analyzed the movement distances and general probability of movement of 13 brown bears (8 males and 5 females) equipped with GPS-collars and monitored over 1-3 years. Our analyses revealed that movement distances and probability of bear movement differed between seasons (mating versus hyperphagia) and reproductive classes. Adult males, solitary females and subadult males showed a crepuscular movement pattern. Compared to other reproductive classes, females with offspring were moving significantly less during crepuscular hours and during the night, particularly during the mating season, suggesting temporal niche partitioning among different reproductive classes. Adult males, solitary females, and in particular subadult males, travelled greater hourly distances during the mating season in May-June compared to the hyperphagia in July-October. Subadult males significantly decreased their movement from the mating season to hyperphagia, whereas females with offspring exhibited an opposite pattern with almost doubling their movement from the mating to hyperphagia season. Our results provide insights how seasonality and reproductive class drive intra-population differences in movement distances and probability of movement in a recovering, to-date little studied, brown bear population in south-eastern Europe.

INTERACTION BETWEEN BROWN BEARS AND WILD BOARS AT ARTIFICIAL FEEDING SITES IN SLOVENIA

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Brown bear and wild boar occupy similar habitats and have overlapping ecological niches in many dimensions. There is a wide overlap in their distribution as well as in their body weight, with bears being heavier on average. They are both omnivores competing for the same food sources. These similarities create great potential for competition for food, including physical interactions that are poorly studied. The goal of the present study was to examine interactions between WB and BB at places with a concentrated food source, namely, artificial feeding sites.

We used camera traps set at 21 artificial feeding sites that are traditionally used for bears in Slovenia. We compared hourly and monthly relative presence of both species at feeding sites. We found there was a minimal difference in their hourly presence, with WB being less common during the day and reaching peak numbers an hour or so later than BB. In other words, most of the BBs were present before 23h and most of WBs were present after 21h. The monthly distribution was also similar, but boars were more frequently captured during the winter months, most likely as a result of bear hibernation.

Further, we studied a possible interaction on pictures and videos where both species were present. We found no active interaction but there was an obvious dominance of bears over wild boars. The latter kept their distance to bears and to feeders if bears were present. The distance to feeders was similar between species if only one species was present.

Our study shows no obvious spatial or temporal avoidance, but where both species are present BB is the dominant species.

VISITORS' PERCEPTION OF THE SOMIEDO AND UBIÑAS NATURE PARKS (CANTABRIAN MOUTAINS, NORTH OF SPAIN) ON NATURE TOURISM AND BEAR WATCHING

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Tourism for wildlife observation has recently experienced an increase in Spain that has extended to large carnivores. This tourism can have positive aspects from the educational and socioeconomic point of view, but it can also generate discomfort or contribute to the habituation of specimens. A clear example of this is the Cantabrian brown bear in the Natural Parks of Asturias. In order to evaluate which conservation actions to take, it is advisable to know the perception and opinion of tourists (hikers and observers).

During the summer of 2018 and 2019, visitors were surveyed in two natural parks of the Cantabrian mountains with the aim of collecting and analyzing their perception of the brown bear and bear sighting tourism. The vast majority of them believe that nature tourism has a positive impact both on the economy of the municipality and on nature itself, with observers giving the highest marks to the benefits of tourist activity for nature. Observers, when assessing the impact of their activity on bears, seem to show a less critical feeling of the possible harm of their activity than hikers. Fifty percent of the hikers were not aware of sighting tourism, but of a list of possible activities, bear watching had the highest preference. Regulating the distances and places of observation are for the observers the main measures to manage the sightings. However, there are a good number (36%) who would use camouflage or "hides", which seems to indicate that they would be happy with more intrusive actions. We discussed the results within the necessary effort, still pending, of regulation and education on how to carry out tourism for the observation of these threatened animals.

LESSONS LEARNED FROM RECENT RESCUE CASES OF FREE-RANGING BLACK BEARS IN TAIWAN

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Habitat encroachment, fragmentation, and illegal hunting have continued to jeopardize the locally endangered population of Formosan black bears (Ursus thibetanus formosanus), a subspecies of Asiatic black bears in Taiwan. Since 2016, several human-bear conflicts and rescuing-bear cases have occurred one after another and aroused enormous attention from media and general public. Meanwhile, it somewhat revealed the scarcity of relevant management professionals and practices of authorities for handling these cases. Thereafter, through reviewing all the case studies, we would like to provide insights and comments for future better management. In order to enhance the capacity building of wildlife managers and related stakeholders from zoos, national parks, and wildlife rescue and rehabilitation organizations, we hold a workshop of “Developing guidelines for Formosan black bear rescue and management of human-bear conflicts” in October 2019. This was the first formal meeting of rescue issues with a focus on single terrestrial mammal species in Taiwan. Nine recent human-bear conflict cases and nine rescue cases of free-ranging bears were reported, including 3 orphaned cubs, 2 natural illness of bears, and 4 caught by illegal snares. During the workshop, a questionnaire survey was conducted among 41 staffs from relevant authorities. The majority of participants (92.7%) agreed the importance of the workshop theme. However, only 26.8% of respondents felt confident about the knowledge and expertise in processing these bear rescues or conflict situations. Other requirements for improving management capacity were further recommended, including establishing qualified rescue facility for bears (84.5% agreement), organizing a core working group for “bear emergency” (75%), collaborating with non-profit organization, such as Taiwan Black Bear Conservation Association (71.9%), establishing an inter-organizational network for bear sighting reports (59.4%), and developing standard instruction for managing various bear issues (59.4%). Further conservation outreach programs were also encouraged and discussed for bear-people coexistence.

SITE SELECTION OF POLAR BEAR MATERNAL DENS IN THE HUDSON BAY LOWLANDS OF ONTARIO

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Sea ice in Hudson Bay melts completely during summer, forcing polar bears ashore for several months until the ice re-forms in the fall. For pregnant females, the ice-free period coincides with the timing of den construction, meaning all maternity denning in the southern Hudson Bay ecosystem occurs on land. Throughout the Hudson Bay lowlands of Ontario, pregnant females typically construct dens in features associated with permafrost, such as palsas and peat banks adjacent to small lakes. Climate-mediated reductions in permafrost, as well as changes in snow conditions, are expected to reduce the availability and/or quality of these habitat features and may result in attendant shifts in the distribution of polar bear maternity dens. Further, changing sea ice conditions may necessitate changes in migratory patterns that make denning more energetically expensive, as polar bears may have to travel greater distances to find suitable habitat. Despite these potential impacts, the effects of climate change on denning behaviour in southern Hudson Bay are largely unknown. We sought to characterize the microhabitat features of den sites and examine how variation in denning phenology is affected by environmental conditions. We used a resource selection function framework to characterize the habitat characteristics of polar bear dens. Using data from 51 den sites, we examined habitat covariates including slope, aspect, tree cover, and distance to water relative to available sites throughout southern Hudson Bay. Survival rates and mean body condition of pregnant females in this region have declined since the 1980s, likely due in part to earlier sea ice retreat and loss of hunting opportunities. Deterioration of critical habitat and increased energetic demands associated with den selection are expected to have significant effects on reproductive success and perhaps female and cub survival. Future work will involve modelling the effects of climate warming on denning habitat availability.

ESTIMATING BLACK BEAR DENSITY IN WESTERN WASHINGTON'S WHITE RIVER DRAINAGE USING NON-INVASIVE HAIR SNAGS

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The Muckleshoot Indian Tribe has a history of managing big game based on science and sound biological principles. To better understand and manage black bear (Ursus americanus) in the Tribe's ceded treaty area of western Washington we are studying bear density among other aspects of local bear ecology. To determine density of black bear in the 585km2 White River drainage study area we used genetic data collected through non-invasive sampling techniques with 63 barb wire hair snags and a scented lure. We baited the hair snags weekly for four weeks per year for two years and collected hair samples for genotyping done by the University of Idaho's Laboratory for Ecological, Evolutionary and Conservation Genetics. We then used program Density 5.0's spatially explicit capture recapture models to estimate density based on individual bears' capture locations. In the 2017 trapping session we submitted 543 hair samples for genotyping. This yielded identification of 63 individual bears and a density estimate of 13 bears/km2. The 2018 trapping session produced 592 samples for genotyping. This yielded identification of 91 bears, 36 of which had been identified the year prior. The 2018 density estimate increased to 16 bears/km2. Bear density and derived abundance estimates will be used in part to facilitate creation of a bear management plan for the Tribe.

IBA VISION AND MISSION

Vision: IBA envisions a world where all 8 bear species can thrive and coexist with humans.

Mission: IBA advances scientific understanding and global conservation of the world's 8 bear species.

Goals and Objectives:

1. Promote and foster well-designed research of the highest professional standards.
2. Support sound stewardship of the of the world's bears through scientifically based population and habitat management.
3. Publish and distribute, through its conferences and publications, peer-reviewed scientific and technical information of high quality addressing broad issues of ecology, conservation and management.
4. Encourage communication and collaboration across scientific disciplines and among bear researchers and managers through conferences, workshops and newsletters.
5. Increase public awareness and understanding of bear ecology, conservation, and management by encouraging the translation of technical information into popular literature and other media, as well as through other educational forums.
6. Encourage the professional growth and development of our members.
7. Provide professional counsel and advice on issues of natural resource policy related to bear management and conservation.
8. Maintain the highest standards of professional ethics and scientific integrity.
9. Encourage full international participation in the IBA through the setting of conferences, active recruitment of international members and officers, and through financial support for international research, travel to meetings, member ships, and journal subscriptions.
10. Through its integrated relationship with the Bear Specialist Group of the World Conservation Union (IUCN)/ Species Survival Commission, identify priorities in bear research and management and recruit project proposals to the IBA Grants Program that address these priorities.
11. Build an endowment and a future funding base to provide ongoing support for IBA core functions and for the IBA Grants Program.
12. Support innovative solutions to bear conservation dilemmas that involve local communities as well as national or regional governments and, to the extent possible, address their needs without compromising bear conservation, recognizing that conservation is most successful where human communities are stable and can see the benefits of conservation efforts.
13. Form partnerships with other institutions to achieve conservation goals, where partnerships could provide additional funding, knowledge of geographical areas, or expertise in scientific or non-scientific sectors.


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