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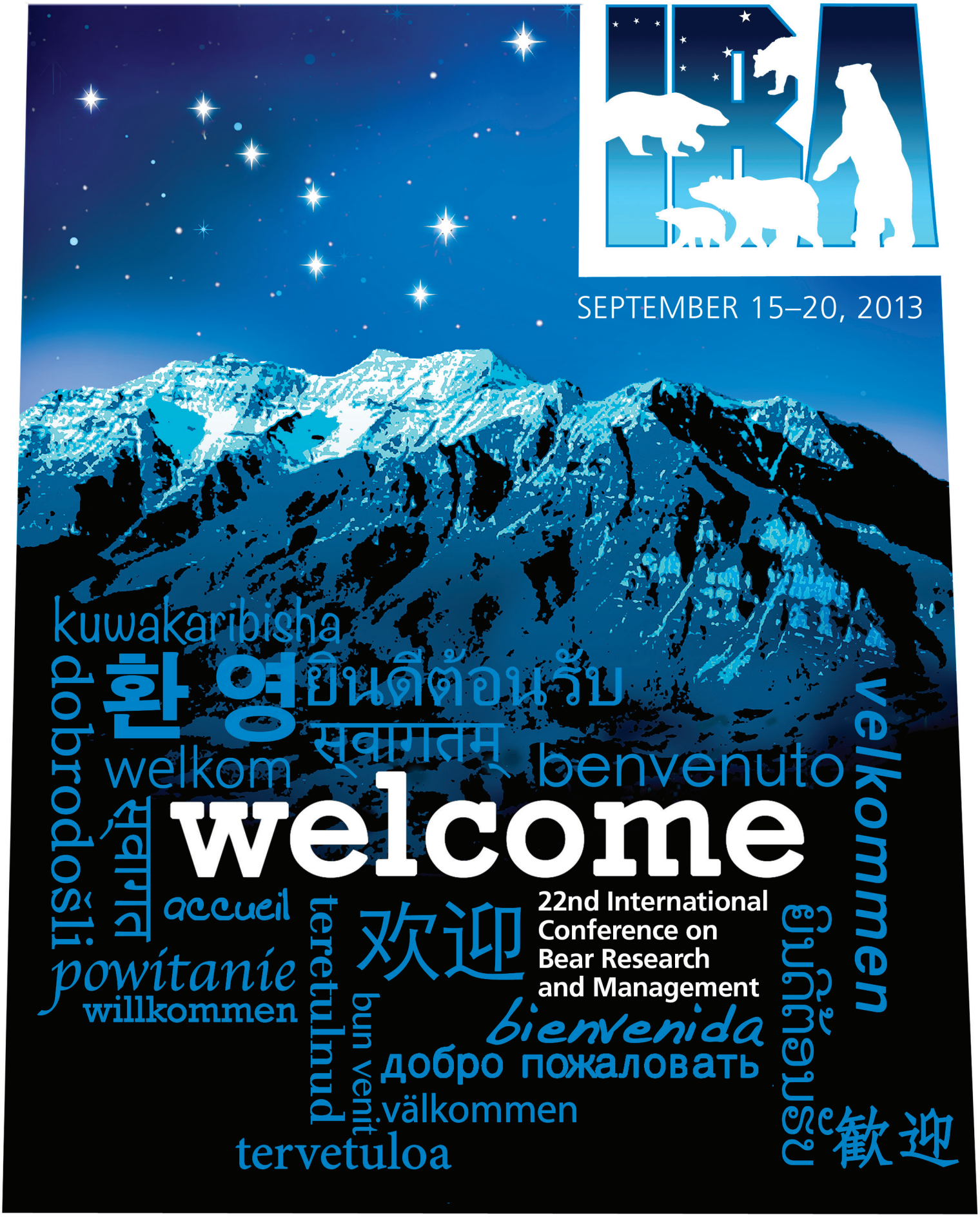


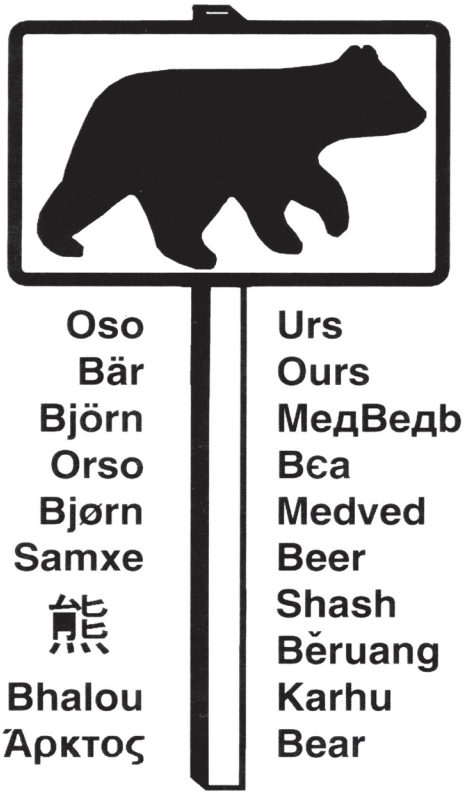
INTERNATIONAL ASSOCIATION FOR BEAR RESEARCH AND MANAGEMENT

The International Association for Bear Research and Management (IBA) sponsors international conferences and workshops about bear biology, research and management. The International Conference on Bear Research and Management is the largest of these conferences and is focused on all eight bear species. The international conferences are rotated between the Americas and Eurasia on an 18-month rotation. Many of the conference papers are published as peer-reviewed papers in the journal *Ursus*.

The IBA is a nonprofit, tax-exempt organization open to professional biologists, wildlife managers and others dedicated to the conservation of all bear species. The organization has over 550 members from over 50 countries. It supports the scientific management of bears through research and distribution of information.

The goal of the association is to promote the conservation and restoration of the world's bears through science-based research, management and education.

The eight bear species of the world pose significant research and management problems to governments, local authorities, wildlife biologists, land managers, park personnel, tribal councils, and private landowners. The public endures hardships caused by bears; the public wants bears to survive. Management responsibility for the bears and their habitats rests with numerous national and local agencies and councils. Encroaching civilization, involving land-use conflicts and resource utilization by human beings, has resulted in the decline or disappearance of bear habitat and bear populations in portions of their ranges. Continued viability of populations and the possible restoration of bears in certain areas will be largely contingent upon a cooperative approach towards research, management, land use, and education, and will increase in cost as land values escalate. The IBA, an association primarily of professional biologists with an interest in bears, recognizes these difficult bear research and management problems faced by agencies and governments.



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Session I
HIBERNATION: PHYSIOLOGY I

Bone Metabolism in Hibernating Bears Prevents Osteoporosis

Seth W. Donahue[1], Meghan McGee-Lawrence[2], Mike Vaughan[3], O. Lynne Nelson[4], Charlie T. Robbins[4], and Hal L. Black[5]

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During physical inactivity, bone resorption increases and bone formation decreases in non-hibernating animals. This imbalance in bone remodeling leads to net bone loss, increased bone porosity, and reduced bone strength, which increases fracture risk. Mineral loss from bone is reflected by increased serum and urine calcium concentrations. Hibernating bears have decreased bone turnover during hibernation, consistent with energy conservation. Furthermore, bears uniquely have balanced bone resorption and formation during this period of physical inactivity. Balanced bone remodeling maintains serum calcium concentration at normal levels despite anuria. Bone porosity, mineral content, and strength are preserved during hibernation in wild black bears and captive grizzly bears. This is also attributed to balanced bone remodeling. Decreased bone turnover is believed to be centrally regulated as part of global metabolic suppression, as bone remodeling is energetically expensive. Balance between bone resorption and formation is believed to be maintained by calcium regulatory hormones to maintain eucalcemia. Bone has recently been shown to influence fat and energy metabolism in mice via the hormone osteocalcin. Serum glucose, insulin, and adiponectin were about 30% lower in hibernating bears and osteocalcin was about 75% higher than during the summer. This suggests a different relationship between osteocalcin and energy metabolism in bears and mice. However, osteocalcin is known to accumulate in serum with reduced renal function, which confounds the interpretation of osteocalcin effects on energy metabolism in hibernating bears. The serum blood urea nitrogen (BUN): creatinine concentration ratio was markedly lower in hibernating bears than in active bears. The (neuro) endocrine regulation of bone in hibernating bears is still mysterious. The potential roles of NPY and serotonin and other possible regulators of bone metabolism will also be discussed.

Muscle Protein and Strength Retention by Overwintering Black Bears in the Wild

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In their field den for 5 months, naturally hibernating black bears (Ursus americanus) maintain core temperatures only 3–6° C below euthermia. They also exhibit distinct phases of adaptive nutrition states: fall hyperphagia with resultant large fat reserves associated with a high proportion of polyunsaturated fatty acids and elevated leptin levels perhaps initiate the onset of anorexia and the bear's entrance into a Phase II fast. Both early and late denning echocardiography and 12 lead ECGs revealed no left ventricular atrophy. In this same population using implanted data loggers, we observed that during hibernation these bears also elicit dramatic respiratory sinus arrhythmias (with long pauses between breaths (respiratory rates of 2–3 per min) and heart rates as low as 4 bpm, which correlates with reduced energy expenditures and potentially contributes to conserved cardiac proteins. Temporal skeletal muscle biopsies showed no loss of fiber numbers, cross-sectional areas or consistent transitions of SO to FG isoforms, and overall little or no nitrogen loss. We observed that protein synthesis rates were higher than degradation during the summer: i.e., synthesis and breakdown decreased from summer to fall with a concomitant drop in RNA, RNA/ DNA ratio and an elevated $\delta\ ^{15}N$ in skeletal muscles. But all these biochemical parameters then remained relatively unchanged throughout the remaining months of denning. We also found that not all muscles behave identically during fasting: potential protein synthesis in selected muscles may be utilizing amino acids from other marginal degraded muscles in concert with proteolysis of collagen (elevated hydroxyproline and glycine),

kidney (elevated serine) and gastrointestinal tract (high alpha amino acids) proteins: e.g., we observed a little or no loss of vastus lateralis forces (an antigravity muscle) and ~25% loss of the dorsiflexors. Note, our ^{15}N labeled urea studies on small mammals shows a 10–40 fold uprergulation of urea nitrogen salvaging during fasting and torpor which we believed also occur in bears. Subtle muscle contraction patterns throughout (e.g., thermogenic shiver) the denning period with peripheral vasodilation may work in concert with conserved protein and fiber morphology for bears to exhibit only marginal losses of skeletal muscle strengths measured both in vivo and in vitro and remarkable wound healing abilities.

Serum Proteome of Black Bears Reveals Modulation of Immune-Related Proteins During Hibernation

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Hibernation is an adaptation that allows animals to conserve energy in the face of extreme environmental conditions and low food availability. This phenomenon is characterized by a lowering of body temperature and metabolic rate, thereby conserving energy substrate resources during prolonged hibernation. However, the physiological and biochemical changes that characterize the hibernation phenotype, especially maintenance of the health of the animal are far from clear. The objective of this study was to profile the serum proteome of the American black bear *(Ursus americanus)* to identify differentially expressed proteins in order to provide novel insights into the biochemical adaptation to hibernation in bears. The serum proteome changes were assessed using a two-dimensional difference gel electrophoresis (DIGE) approach from the same animal ($n = 4$) prior to and during hibernation. The proteins were identified by mass spectrometry and a subset of these proteins were also confirmed to be differentially regulated using SDS PAGE followed by immunodetection (n = 8). We identified 70 serum proteins to be differentially expressed during hibernation in bears, out of which 34 were upregulated while the rest were downregulated during hibernation. Specifically, hibernation in black bears was associated with differential expression of serum proteins involved in immunity, coagulation, and bone metabolism. The majority of the differentially expressed proteins, including α2-macroglobulin, complement components C1s and C4, immunoglobulin μ and J chains, clusterin, haptoglobin, C4b binding protein, kininogen 1, α_2-HS-glycoprotein, and apoplipoproteins A-I and A-IV, have a role in the immune system processes. The differential expression of serum immune-related proteins may confer a survival advantage by enhancing processes that prevent infections and diseases during prolonged hibernation in black bear. We hypothesize that differential modulation of serum immune-related proteins is a key adaptation for the maintenance of animal health during prolonged hibernation, including increased capacities for bone maintenance and wound healing in bears.

Cardiac Responsiveness to Adrenergic Stimulus in Hibernating Bears

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Hibernating bears have a remarkable ability to conserve energy, even in vital organs such as the heart. Intrinsic cardiac adaptations allow for maximal efficiency during periods of dramatically slower heart rates in the winter. Yet grizzly bears are able to instantaneously increase their heart rate, cardiac output, and mobility to near normal levels when they feel threatened. We wanted to examine the ability of the hibernating grizzly bear to respond to an adrenergic stimulus. We hypothesized that bears would be able to respond to adrenergic stimulation but perhaps to a lesser degree than in the active period.

Four trained grizzly bears were used to examine the effects of a β-adrenergic receptor agonist (synthetic adrenaline), isoproterenol (ISO), on heart rate and cardiac function during the active and hibernating period. ISO was given intramuscularly at 0.6 μg/kg and cardiac parameters were assessed pre and post injection by echocardiography. Heart rate (HR), left ventricular ejection fraction (LVEF), left atrial ejection fraction (LAEF), LV filling volume, cardiac output index (CI) were measured.

Heart rate and LV ejection function were more sensitive to ISO during hibernation. Heart rate increased by 47% during the active period and 230% during hibernation after ISO administration. LV filling volume was not impaired by ISO induced tachycardia during hibernation as it was during the active period. LVEF surpassed the active period LVEF measure. Left atrial (LA) ejection which was minimal during hibernation before ISO increased to normal active period measures.

Grizzly bears demonstrated a greater response to adrenergic stimulation during hibernation than during the active period. This may explain the quick response phenomenon when bears are disturbed in the den. The bears increased cardiac output responsiveness without sacrificing LV filling (the time of myocardial perfusion). These findings would suggest a very robust but efficient myocardial response to work during hibernation.

Session 2
HIBERNATION PHYSIOLOGY II

Thermoregulation and Energetics in Hibernating Black Bears—The Mystery of Multiday Body Temperature Cycles

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Black bears overwintering in outdoor hibernacula in Fairbanks, Alaska decrease whole body metabolic rate to a minimum of 25% with a midwinter average of 37% of basal levels, and takes 3 weeks to recover after emergence in the spring. Core body temperature (T_b) decreases from summer levels of 37-38 °C to a hibernation average of 33 °C and develops cycles of 2–7 days period length with a 30–36 °C range. Hibernating black bears intermittently shiver at den temperatures (T_{den})< ~0 °C, during the rising phase of the T_b cycles and move infrequently (gross activity once every 0.5–2 days). It is not known what causes the T_b cycles and how they are modulated, although avoiding T_b of <30 °C and heat loss mechanisms could be involved. In the latter case it is expected that high heat loss due to cold conditions and small body size would cause more rapid cooling and shorter cycles than during warmer conditions and large body size. To investigate this we kept 12 hibernating bears with body mass (BM) from 35.5–116.5 kg in outdoor hibernacula, which could be thermostatically controlled with electrical heating mattresses behind two walls. We continuously sampled air from the dens to record metabolic rate. T_b and shivering was recorded with intraperitoneal data loggers and radio telemetry, T_{den} and outside temperatures with thermocouples, and activity with microwave movement detectors. In mid hibernation, each bear had a unique response pattern with the Tb cycle length moderately to strongly correlated to T_{den} (Mean R2 = 0.70, range 0.37–0.95). At higher T_{den} (2–6 °C) the pattern was more irregular and often only minor (<1 °C) variations in T_b remained. Amplitude spectra indicated no consistent circadian frequency component in the T_{den} pattern. Activity occurred at random independently of T_b, and did not show circadian rhythms in mid-hibernation as long as the den was closed (dark). Average metabolic heat production though whole T_b cycles was negatively correlated to T_{den} below lower critical temperature (which is much higher than in non-hibernating bears). Large bears showed more variation in period length with T_{den} than small bears. Total body thermal conductance was as expected negatively correlated to BM (R^2 = 0.73), but large bears had the same or shorter cycle length than small bears except at a T_{den} close to the lower critical temperature. We conclude that the T_b cycling is related to thermoregulatory heat production by shivering, and that deep T_b cycling may not be present when hibernating bears use passive thermoregulation. Rate of heat loss alone cannot explain the variability in cycle length as small bears contrary to what is expected show longer cycles than large bears at low T_{den}. Bears hibernating in cold conditions use more energy during hibernation than in warmer conditions, but energy expenditure due to intermittent activity

(for instance caused by moderate disturbance) is predicted to not increase long term energy costs because it can replace heat produced by shivering. This work was supported by U.S. Army Medical Research and Materiel command awards W81XWH-06-1-0121 and W81XWH-09-2-0134.

Human Cardiac Monitoring Technologies Help Advance Understanding of Free-ranging American Black Bears

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Physiological data loggers designed for humans have applications for monitoring free-ranging bears. Our research team, including representatives from the medical device industry, academia, and a state management agency, collaborated to design studies that utilized such devices in American black bears *(Ursus americanus)*. Here we review the history of our efforts over the past 15 years, highlighting advancements in the devices, types of questions that can be addressed, salient results, persistent problems, and desired future improvements. Notable findings from devices implanted in hibernating wild bears included: (1) dramatic respiratory sinus cardiac arrhythmias, (2) respiratory rates of 2–4 breaths per minute, and (3) both tonic and shiver electromyographic patterns, which we believe were thermogenic in nature. The 80 cc devices that we originally used had a high foreign body rejection rate (not previously seen in humans or other species). Subsequently, we employed a much smaller (9 cc), commercially available Insertable Cardiac Monitor (Reveal Plus, DX, and XT, Medtronic, Inc.), which enabled us to monitor annual trends in heart rates (HR) and general activity levels. Observations included periods with extremely rapid HR, some of which we could match to specific events (e.g., up to 261 bpm in a bear shot by a hunter), as well as periods with very slow HR (pauses between heart beats of up to 15.7 seconds during hibernation). Even though it occurred less frequently, these small devices were often rejected, spurring us to investigate the timing and cause of this unique response in bears. In addition, we are currently evaluating a prototype software patch for the Reveal XT device that dramatically increases the recording frequencies (average HR every 2 min and activity every 15 min). Particularly interesting results obtained thus far relate to the extent and duration of disturbance caused by drugging and handling bears at den sites, and how birthing effects the hibernation of mother bears. Human cardiac monitors will soon include wireless telemetry, temperature, and posture sensing capabilities, which will provide more novel insights into adaptations of bears to their environment.

Energetics of Hibernation and Reproductive Trade-offs in Brown Bears

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For grizzly bears, hibernation is not only a time of fasting, but is also a time for reproductively active females to give birth and nurture young. During this period, bears use body reserves to support energy and protein costs for maintenance and reproduction. Limitations in body mass may restrict reproductive investment. We developed a model simulation to assess the energetic costs of reproduction during hibernation and to determine how maternal condition, length of lactation, litter size, and length of hibernation affect grizzly bear reproductive success. The model simulates the energetic balance of hibernating bears by integrating the main metabolic mechanisms that determine the use of lean and fat reserves during hibernation for non-lactating and lactating bears. Each day the model accounts for the use of lean and fat reserves to supply

the energy and protein costs of hibernation using two separate pathways (i.e., one for lean and other for fat). Our results illustrate that increasing litter size by one cub was more costly than increasing the lactation period by 14 days. Protein requirements for reproduction accounted for more than 77% of the loss of body mass during lactation and between 9% and 35% of the total body mass loss during the entire hibernation. Minimum levels of fat reserves necessary to support reproduction differ by environmental conditions. Females in populations experiencing longer fasts should avoid 'costly' reproductive investment by reducing litter size and decreasing the length of lactation. While the importance of fat or energy at the beginning of hibernation has been long recognized, the importance of foods containing protein at the beginning of the active period has not. Therefore, more attention should be given to understanding factors affecting lean mass accumulation during the active period, as well as how environmental variation affects populations of bears.

Changes in Blood Oxygen Transport in Hibernating Brown Bears

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Strong suppression of metabolic rate is a key characteristic of all known hibernators. During winter hibernation, bears reduce basal oxygen (O_2) consumption rate to ~25% compared to the active state, whilst body temperature decreases moderately (to ~30–32 °C), suggesting a temperature-independent component in their metabolic depression. To establish whether such drastic changes in O_2 consumption correlate with changes in the ability of the blood to bind and release O_2, as part of the Scandinavian Brown Bear Research Project we took blood samples from the same six (GPS-tracked and anesthetized) individuals of hibernating and non-hibernating free-ranging brown bears in Dalarna, Sweden, during winter and summer, respectively. We found a higher blood O_2 affinity in hibernating bears and demonstrated that this was due in part to a reduced red blood cell content of 2,3-diphosphoglycerate (DPG), the major allosteric effector of the blood O_2 carrier hemoglobin (Hb), and in part to the reduced body temperature (Revsbech et al. 2013). DPG was observed to decrease from summer levels of ~2 to winter levels of ~1 DPG per Hb molecule. Thus combined decreases in DPG levels and body temperature have the effect to increase the Hb-O_2 affinity and to cause an overall left-shift of the O_2 binding curve in hibernating brown bears. This results in O_2 being more tightly bound to the Hb and would effectively limit O_2 release to tissues when O_2 consumption is reduced, as in hibernation. These findings indicate that in bears O_2 supply by the Hb is tightly coupled to red blood cell metabolites and ultimately to the metabolic status of the organism. Because of a body temperature and size more directly comparable to human physiology, bears are a valuable translational model to better understand natural mechanisms for organ and cellular protection during comatose states and other forms of inactivity in human patients.

Revsbech, I.G., et al. 2013. Decrease in the red cell cofactor 2,3-diphosphoglycerate increases hemoglobin oxygen affinity in the hibernating brown bear Ursus arctos. American Journal of Physiology - Regulatory, Integrative and Comparative Physiology 304, R43–R49.

Treatment of Human Degenerative Diseases and Bear Hibernation

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According to Ben Cao Gang Mu, a comprehensive 16th century Chinese herbal medicine text, Chinese bear bile containing conjugated and unconjugated ursodeoxycholic acid (total UDCA) as a major component has been used for over 3000 years not as a tonic or a nutritional supplement, but as a medical treatment for fever fighting, detoxification, inflammation,

swelling and pain reduction without toxicity. UDCA and other bile acids, acidic steroid, are potent intracellular signaling molecules with crucial regulatory properties such as metabolic pathway and immune-inflammatory axes and they mutually act as competitive antagonist. They also have antibacterial activity due to their detergent properties.

In bears, more than 67% of bile acids in bear are taurine conjugated, 17% are glycine conjugated and only 15% are unconjugated species. UDCA (1%–39%) was found to be the primary bile acid produced in the liver of bears and is the second major bile acid, representing 28% of the total bile acids in the bear plasma.

The gastrointestinal system during hibernation has continuous, low-grade inflammation, because of exposure to antigenic load from luminal bacteria and various Toll-like receptor (TLR) ligands. The accumulation of immune cell populations induced by chronic inflammation altered gut microbiota composition, followed by serious consequences for the host health.

During hibernation, the proportion of non-toxic hydrophilic total UDCA was markedly higher compared with summer active bears (31.5 ± 3.2 versus 22.2 ± 4.5%). Increase of the hydrophilicity of gastrointestinal tract by total UDCA during hibernation may prevent gut inflammation and atrophy, lithogenesis, bacterial overgrowth, skeletal muscle deterioration, heart damage and brain damage.

The bear does not consume food or water and excretes only CO_2 and water as insensible respiration in the breath during the dormant period. This remarkable metabolic stability of the dormant bear may be contributed by the well balanced brain–gut–microbiome communication directly associated with total UDCA and other bile acid. This communication system is bidirectional, enabling the brain to influence gastrointestinal functions as well as systemic immune functions.

The health of elderly humans with increasing vulnerability to diseases, particularly degenerative diseases, depends on the well balanced brain–gut–microbiome communication. Aging, a progressive degenerative process tightly integrated with inflammation, is associated with altered physiological functions, including immune system functions, which affect gut microbiota composition. The world population is aging at an alarming rate with the number of people aged 60 years and older projected to triple from 2000 to 2050, reaching nearly 2 billion.

Study for physiological functions of total UDCA in bear hibernation which is the most evolutionary advanced physiological and behavioral phenomena under the prolonged, seasonal periods of energy shortage leads to develop a drug which overall delays the progression of degeneration through blocking inflammatory cytokines induced by altered microbiome of the gut. This drug has to be comparable to physiological functions and therapeutic effects of total UDCA during hibernation.

Aqueous solubilized UDCA (Yoo's solution), a single molecule of nontoxic systemic aqueous solubilized UDCA having steroidal anti-inflammatory, membrane stabilizing, anti-aggregative, anti-apoptotic and anti-oxidative properties is developed.

Presence of Spontaneous Echo Contrast and Low Cardiac Output as a Physiological Phenomenon in Hibernating, Free-Ranging Scandinavian Brown Bears (*Ursus arctos*)

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Background. Spontaneous echo contrast (SEC) visualized with cardiac ultrasound (echocardiography) is the presence of swirling echo dense shadows in the cardiac chambers and great vessels. In humans, SEC is almost exclusively associated with low blood-flow conditions present in heart diseases, such as rhythm and valve disorders and heart failure. When present, SEC is strongly associated with both previous and the risk of future thromboembolic events. SEC has not previously been described in hibernating bears.

Methods. Echocardiography was performed on seven denning, free-ranging Scandinavian brown bears (Ursus arctos), anesthetized with medetomidine-tiletamine-zolazepam, during last week of February 2013. Cardiac output was measured noninvasively using estimates of hemodynamics obtained by Pulsed Wave Doppler Echocardiography and 2D imaging.

Results. SEC was present in the cardiac chambers in all 7 bears, indicating low flow conditions, though no atrial arrhythmias or valve dysfunctions were present. The presence of SEC allowed for the visual assessment of blood flow, which revealed stationary conditions during a substantial part of the diastole. Furthermore, the time spent in diastole was considerable, owing to a mean heart rate of 25.9 (SD: 5.1) bpm. Low blood flow was additionally documented by noninvasive measurements of hemodynamic parameters: mean stroke volume was 24.0 (SD: 3.7) mL and mean cardiac output was 617 (SD: 127) mL/min. The cardiac index, which relates cardiac output to body surface area, was 0.48 (SD: 0.08) mL/min/m^2, compared with a normal value of 3.5 (SD: 0.7) mL/min/m^2 in humans.

Conclusion. Despite the presence of SEC and low flow hemodynamics during hibernation, the free-ranging Scandinavian brown bear seems to be free of thromboembolic episodes during its 5–6 months of hibernation. This apparent paradox raises the question of whether its coagulation system simply is less prone to thrombus formation, undergoes unique adaptation during hibernation, or whether an unknown factor protects the bear from thromboembolism during hibernation.

Session 3
EURASIAN BEARS

Giant Panda Foraging Strategies and Bamboo as a Seasonally Limiting Resource

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In response to seasonal variation in quality and quantity of available plant biomass, herbivorous foragers may alternate among different plant resources to meet nutritional requirements. Giant pandas (*Ailuropoda melanoleuca*) are reliant almost exclusively on bamboo which appears omnipresent in most occupied habitat, but subtle seasonal variation in bamboo quality may still influence foraging strategies with population-level effects. Panda foraging is constrained by a simple digestive system and many aspects of their life-history strategy appears governed by energy limitation, making this species a good model for studying fitness impacts of foraging decisions. Seasonally limiting resources may influence carrying capacity and are a cornerstone of conservation biology. Foraging strategies characterize individual animal's response to seasonal resource fluctuation and wed individual decision-making to population regulation. We examined (1) bamboo availability in panda foraging habitat and documented changes in nutritional quality, (2) changes in diet across seasons as determined by fecal sample analysis and (3) changes in diet as determined by feeding signs. In addition, we examined rangewide records of mortality and rescues of weakened animals to determine possible seasonality in mortality coincident with seasonally restricted food resources. Our data on foraging indicate that pandas in late winter and early spring consumed a less optimal diet, as the availability of the most nutritious and preferred bamboo declined, suggesting that bamboo may be a seasonally limiting resource. If seasonally limiting food supplies affect survival, then mortality should be disproportionately common during the season of lowest food quality and quantity. Consistent with this hypothesis, almost all panda mortalities and rescues (presumed mortalities averted) have occurred during the same period of seasonal food limitation. Our findings raise the possibility that while total bamboo biomass may not be a limiting factor, carrying capacity may be influenced by subtle seasonal variation in bamboo quality. We recommend that managers and policy-makers should consider more than just the quantity of bamboo in the understory and that carrying capacity estimates should be revised downward to reflect the fact that all bamboo is not equal.

Analysis of Environmental Factors Regulating Seasonality of Birth in Giant Pandas (*Ailuropoda melanoleuca*)

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Environmental regulation of seasonal reproduction in giant pandas (*Ailuropoda melanoleuca*) has yet to be elucidated. The goal of the present study was to identify the principal environmental factors that influence the seasonal timing of birth in giant pandas, and thereby guide future research to elucidate mechanisms of seasonality. Because the timing of birth is controlled by the timing of implantation, which in turn is controlled by the timing of corpora lutea reactivation (CLR), we predicted that zeitgebers would most strongly correlate with the CLR date and implantation date, compared to birth date. Correlation tests and linear regression analyses were conducted to examine temporal relationships between each of three reproductive events related to birth timing (Julian birth date, estimated implantation date, and estimated CLR date) and each of four environmental factors likely to serve as zeitgebers (latitude, temperature, rainfall, bamboo consumption) in giant pandas. Captive giant panda birth dates were collected from the 1963–2011 international zoo studbook records (n = 318 litters) and used to estimate implantation (birth date–30 days) and CLR (birth–50 days) dates. Latitude (degrees North)

at which the pandas lived, ranging from 19–48°N, was not significantly associated with the timing of birth, implantation, or CLR. Similarly, average rainfall during the month when the reproductive event occurred was not related to the timing of birth, implantation, or CLR. Comparison of the timing of birth to average temperature at the time revealed a weak negative association (R = –0.348). However, average monthly temperatures at the time of the events were not related to the timing of implantation date or the CLR date, suggesting that temperature is not a zeitgeber in this species. Interestingly, bamboo consumption revealed strong associations with all three reproductive events related to birth timing. Percentage of the bamboo diet comprised of culm was significantly and inversely correlated with birth date (R = –0.601, r^2_{adj} = 0.36, P < 0.0001), implantation date (R = –0.722, r^2_{adj} = 0.519, *P* < 0.0001) and date of CLR (R = –0.745, r^2_{adj} = 0.554, P < 0.0001). In contrast, the percentage of bamboo diet comprised of leaves was significantly and positively correlated with birth date (R = 0.593, r^2_{adj} = 0.351, p < 0.0001), implantation date (R = 0.722, r^2_{adj} = 0.52, P < 0.0001) and CLR date (R = 0.743, r^2_{adj} = 0.551, P < 0.0001). Percentage of bamboo diet comprised of other plant components was not associated with birth date, but was significantly correlated with implantation date (R = –0.583, r^2_{adj} = 0.338, P < 0.0001) and CLR date (R = –0.595, r^2_{adj} = 0.353, P < 0.0001). The current study clearly indicates that examining CLR and implantation dates in a species with delayed implantation reveals stronger associations to potential zeitgebers than does birth date. In addition, we encourage future research to investigate the link between seasonal bamboo consumption and reproductive seasonality in giant pandas.

Status, Distribution, and Conservation Status of Malayan Sun Bear in Northeastern States of India

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Malayan sun bear (*Helarctos malayanus*) remain the least known bear species in the world. We carried out field surveys from 2007 to 2010 to know the status, distribution, and conservation status of sun bear and threats in north-eastern states of India. Informal interviews of villagers living in and around protected areas (PAs) were conducted, and 79 trails in Arunachal Pradesh, 29 in Mizoram, 23 in Nagaland, and 19 in Manipur were walked to collect information on occurrence of sun bear through direct sightings and indirect evidences. During the study period, we conducted a household survey through a well-designed questionnaire format in and around protected areas. We carried out surveys in 278 villages, and out of 2379 respondents, 265 (33.6%), 245 (27.7%), 69 (28.2%) and 165 (35.6%) respondents confirmed the presence of sun bear by direct sighting and indirect evidences in 3 PAs of Arunachal Pradesh, 4 PAs of Mizoram, 2 PAs of Nagaland and 2 PAs of Manipur, respectively. We sighted one sun bear in Mizoram and 2 in Arunachal Pradesh. During the transect survey indirect sign were collected from 1310 sample plots along the 131 transects. While walking on trails, 695, 307 and 183 indirect evidences of sun bear were recorded in Arunachal Pradesh, Mizoram, and Nagaland respectively. Overall status of sun bear was found to be low to medium in and around PAs except Dampa Tiger Reserve and Namdapha Tiger Reserve where its occurrence was relatively high. The potential threats for sun bear were habitat destruction and fragmentation and poaching. Conservation of sun bears should be accorded both International and National priority to deal with poaching for illegal trade of bear body parts. Using new provisions of Indian Wildlife (Protection) Act 1972, conservation and community reserves could be established by different states to protect sun bear populations both within and outside protected area network. Sun bears are now listed as Vulnerable on the IUCN Red List (Fredriksson et al. 2008). Poaching for bears and their body parts is reaching alarming rates in mainland Southeast Asia (Foley et al. 2011). Monitoring of sun bear population trends in key conservation areas will become the next imperative.

The Status and Conservation of Bears in Bhutan

Sonam Wangchuck

TBA

Session 4
HIBERNATION: ECOLOGY

Bear Denning Requirements as Opposed to the Wind Energy Development Plans

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Selection of den sites is certainly one of the most critical choices in the life of bear, especially for the birth-giving females. The bear use of inadequate den or the disturbance during denning will lead to the loss of litter. If frequent and widespread, it may put the whole population to risk. The demand for energy from renewable sources is strongly promoting the use of wind power. The wind turbines in Croatia are often planned to be placed on elevated locations like mountain ridges to catch more wind and to be away from human settlements to avoid disturbing people. It seems that this approach is often putting them in the midst of the most remote and pristine bear habitat. Currently, Croatia is in various stages of building or planning at least 94 wind parks, each with 10 and up to more than 100 turbines, many of them up to 143 m high. Additionally each turbine needs extensive newly constructed access roads, which are up to 20 m wide on curves. Bear den habitat at the locations of 26 brown bear dens in Croatia was analyzed in relation to vegetation cover, terrain elevation, slope, ruggedness, proximity to and density of roads and settlements. Mahalanobis distance modeling was applied to model potential bear denning areas which should be excluded from wind power development. Of the studied area of 8510.5 km^2, only 26.8% was ranked to be highly suitable as bear denning areas. Environmental impact studies lack guidelines to evaluate the effects of wind power structures on bears in general, as well as specifically on their denning. Guidelines exist for impacts on birds and bats, but not for ground dwelling animals including bears and other large carnivores. Here we propose and describe the use of current knowledge on bear den selection and GIS analyses to define the quantitative and spatial criteria to evaluate proposals for construction of wind parks.

Ecophysiology of Den Entry and Exit: Does the Brown Bear "Decide" to Hibernate?

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Most studies on hibernation physiology in Ursids have been done in captive bears, excluding the ecological determinants affecting hibernation. From 2010 to 2012, we studied 25 free-ranging brown bears (12 females, 13 males, aged 5 ± 4 (1–16) years and 78 ± 58 (14–206) kg in south-central Sweden using GPS collars with acceleration and temperature sensors (Vectronics Aerospace AB, Germany), abdominal temperature loggers (Star-Oddi, Iceland) and, in 6 bears, heart rate and activity was recorded using insertable cardiac monitors (ICM) (Reveal XT, Medtronic Inc., USA). Seven bears were killed during legal hunting in the autumn. In October and November, bears decreased their movement levels over a period of 5–10 days before entering a den (based GPS positions). Bears entered the dens before body temperature had declined in 9 of 10 cases. Heart rate and acceleration (ICM) changes occurred immediately after den entry with the majority of the drop occurring in the same day. In the spring, temperatures began to rise gradually from early March until early May, with den exit occurring in the middle of the transition period. However, heart rate changed abruptly upon den exit. In previous studies on metabolic rate in captive bears, the American black bear has had about 50% of normal metabolic rate with normal body temperature during April, indicating a disconnect between thermodynamics and metabolism. In contrast, our study illustrates that the temperature changes are still occurring during this transition period from the hibernating to the active state. Differences could be due to lack of ecological constraints in captive bears, species differences, placement of data loggers or sample size. This is the first study in free-ranging brown bears to document both the physiological and ecological sequence of events associated with den entry and den exit.

Where Do Bears Hibernate? A Global Review

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Bears in north temperate regions are adapted to seasonal absences of food: they are able to endure a prolonged period of fasting (3–7.5 months) with greatly modified metabolic functions (i.e., hibernate). Tropical and subtropical bears, with year-round availability of food, do not have to hibernate. Here, we present the first formal global review of where (e.g., latitude, altitude) and under what conditions (i.e., temperature, food availability) bears hibernate, based on published literature and correspondence with bear biologists. Brown bears (*Ursus arctos*) and American black bears (*U. americanus*) hibernate during winter in all but the most southerly portions of their ranges; Asiatic black bears (*U. thibetanus*), whose geographic range is farther south, hibernate in a smaller portion of their range. In each of these species, all pregnant females den and do not eat until their altricial cubs are mobile enough to walk with them. Likewise, in each of the other bear species, parturient females den and fast for varying periods (weeks to months); some of these fasting periods are sufficiently long that the

mother must be hibernating. We incorporate information on captive bears to further examine hibernation in parturient females. We also present new information on the southern limits of hibernation in Asiatic black bears and possible hibernation by sun bears (*Helarctos malayanus*) in the most northern parts of their range.

Grizzly Bear Denning Chronology and Densite Selection in the Northern Continental Divide Ecosystem Montana: Current Conditions and Ramifications of Predicted Climate Change Scenarios

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Grizzly bears (*Ursus arctos*) have been radio-monitored in the Northern Continental Divide Ecosystem, Montana, since the mid-1970s. As a part of ecological studies, bears were routinely radio-tracked to and from their winter dens, providing information on den-site selection and denning chronology. The practice of monitoring bears equipped with VHF collars from the air has remained constant over the years, but has been complemented by the introduction GPS collars since the early 2000s. We present information on dinning chronology for 100 individual bears from 1987 to 2012 and correlate these data with local climatological data. We report on the topographic and habitat characteristics of approximately 250 den locations. As elsewhere, changes in winter climate are predicted for the study area. Using spatial climatology techniques in a GIS framework, we explore the ramifications of plausible future climate change scenarios on grizzly bear denning ecology.

Overwinter Changes in Grizzly Bear Physical Condition, Denali National Park, Alaska

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Grizzly bear denning behavior was studied in Denali National Park, Alaska USA, by radio-tracking marked bears weekly from fixed-winged aircraft during 1991 through 1993. Body composition was studied from 1994 through 1998 using bioelectrical impedance analysis. Adult females captured in fall and the subsequent spring weighed an average of 138.9 kg in fall (n = 12) and lost an average of 42.5 kg (30.6%) through the winter. Mass loss consisted of body fat ($\bar{x}$ = 25.0 kg) and lean body mass ($\bar{x}$ = 17.5 kg). Daily mass loss of adult females averaged 171 g/d (39.2 g/d/kg$^{0.75}$) compared to 352 g/d (69.0 g/d/kg$^{0.75}$) for brown bears on the Kenai Peninsula. Catabolism of lipid stores accounted for 91.1% of body energy used to meet maintenance demands. Adult males had less fat mass in spring than fall but total body mass and lean body mass did not differ significantly. Adult males, subadult males, and subadult females all amassed the same proportion of body fat by early fall, but adult males had a significantly higher percentage of body fat during spring sampling. Female brown bears without cubs in the spring averaged 8.4% body fat in Denali (n = 16) compared to 22.6% body fat on the Kenai Peninsula. Lone adult females in the fall averaged 28.1% body fat in Denali (n = 42) compared to 36.6% for Kenai brown bears and 40.8% for polar bears on the west coast of Hudson Bay, Canada. Bears in northern latitudes that are restricted to terrestrial diets may have reduced ability to put on fat stores with implications for cub production and survival.

Session 5
HIBERNATION: BEHAVIOR

Circadian Rhythms in Hibernating Bears—A Riddle, Wrapped in a Mystery, Surrounding a Function

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Hibernation in bears is characterized by reversible obesity, metabolic suppression and extreme reductions in activity/energy expenditure. Studies in bears have provided evidence both for and against the expression of circadian rhythms during hibernation. To explore this further, we quantified activity in (1) captive brown bears (n = 4–8) housed individually and under constant environmental conditions and (2) a single black bear during hibernation under natural conditions in the wild. All bears were fitted with accelerometers to measure activity. The black bear was also fitted with light and temperature sensors to monitor environmental conditions in the den. We also performed in vitro studies using fibroblasts obtained from brown bear skin biopsies (n = 4) to assay the molecular circadian clock directly. The bear fibroblasts were transduced with a lentivirus containing the mouse *Bmal*1 promoter driving luciferase expression. Bioluminescence cycles were then monitored for several days. Circadian data were analyzed using standard chronobiological methods. Collectively, the results reveal free-running circadian rhythms in both captive brown bears and in the black bear hibernating in the wild. Rhythm robustness was not stable during hibernation, and in both bear species varied over the course of hibernation. For the wild black bear, periods of complete darkness were associated with free-running activity rhythms (i.e., ≠24 h) while light exposure in the den restored a 24-h periodicity, suggesting entrainment of the circadian clock. Interestingly, ambient temperature recorded in the den and in close proximity to the bear remained extraordinarily stable over a 4-month period ($\bar{x}$ = 33.86 °C, SD = 1.84). Captive brown bears housed in constant conditions of light and temperature expressed clear free-running circadian activity rhythms (constant light: 24.3 ± 0.17h; constant darkness: 24.5h). Circadian rhythms were stably entrained to a 24-h period when bears were exposed to an alternating light-dark (11:1:11:1 L:D) cycle. *In vitro* studies revealed circadian rhythms of approximately equal amplitude in all samples of cultured bear fibroblasts. Together, our *in vivo* and *in vitro* results suggest that circadian rhythmicity and photic responsiveness are maintained during hibernation. Although the precise function of these rhythms during hibernation remains to be determined, they may be essential to surviving the obesity, inactivity and prolonged fasting experienced by bears during this hypometabolic period.

Black Bear Behavior in Seven Dens in Northeastern Minnesota, 2010–2013

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The 5–7 months black bears (*Ursus americanus*) spend in dens in northern regions represent the least observed half of their lives. Advances in webcam and cellular technology enabled us to observe undisturbed behavior in remote dens of wild black bears. During 2010–2013, we installed video cameras and microphones in 6 dens in northeastern Minnesota and transmitted continuous live video and sound from before 8 January until dens were vacated in spring. Occupants included 2 mothers and their 7 offspring (4 litters). To determine daily time budgets, >100 collaborators recorded standardized data, minute-by-minute, during the 4 winters by using live or archived video footage. Sound recorded in a seventh den containing a third mother and her yearling female provided additional data on frequency of suckling by yearlings. The remote recordings revealed activities not reported from direct observations. In this presentation, remote videos document the bears

eating snow, icicles, foot pads, and a fecal plug; urinating; defecating; nursing; responding to cubs' cries; caring for cubs; playing; rearranging bedding; sleeping; and reacting to perceived danger. Video recordings before and during the 7 births include den preparations, physical changes in mothers' bodies, labor (up to 22 hours), and parturition. Cub development and eye-opening are shown. All 5 yearlings suckled throughout the denning period.

Winter Sleep with Room Service: Effects of Supplemental Feeding on Denning Behavior of Brown Bear (*Ursus arctos*)

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Supplemental feeding of bears is a controversial measure that is used for various purposes, including assumed reduction of human-bear conflicts. Although intensively practiced in some regions, positive and negative effects of supplemental feeding of bears is poorly understood. Supplemental feeding can strongly affect food availability for bears, especially during winter, when food is scarce. We predicted that supplemental feeding could influence denning of bears. To test this hypothesis, we compared denning behavior of European brown bears in Slovenia where intensive supplemental feeding is practiced with neighboring Italy (Trentino) where no artificial feeding of bears is allowed. We analyzed telemetry data for 28 bears (16 in Slovenia, 12 in Italy) monitored over 42 winters and compared dates of den entrance and den exit, number of days spent in a den, and number of interruptions of denning. Denning of bears in the area with supplemental feeding was on average 20% shorter and bears entered dens later and exited from them earlier. In addition, we noted that 61% bears in the area with supplemental feeding interrupted denning (up to 4 times per winter), while such behavior was never observed in the area without supplemental feeding. The differences in denning behavior between the study areas were greater for males than for females. Telemetry data indicated that bears in Slovenia regularly visited supplemental feeding sites during denning interruptions. These visits to the feeding sites in winter were more frequent than during other parts of the year. Diet analysis of scats collected in this area indicated that during winter bears were feeding mainly on anthropogenic food sources. Shorter denning period and frequent interruptions with active searching for food during winter also increases potential for human-bear conflicts. However, we did not observe increase in reported damages during denning period in area with supplemental feeding.

Relaxation of Selective Pressures and Expression of Ecological Plasticity: An Example in Brown and American Black Bear Den Behavior

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The suspected causal mechanisms and den chronology patterns of the American black bear (*Ursus americanus*) and brown bear (*U. arctos*) have been studied across most of their present range in North America. Generally these studies have been limited to single populations and a comprehensive review is lacking. We identified 40 publications and datasets reporting den chronology for American black bear (n = 27) and brown bear (n = 13) populations in North America. We used meta-analyses to investigate proximate causal mechanisms and sources of variability of den chronology within and among populations. Using generalized linear mixed-effects models, we evaluated factors influencing primary production and foraging efficiency that we determined to be ecologically important and may influence den chronology. We used population level effect sizes of reproductive groups (parturient females, non-parturient females, and subadults), den entrance dates, and den duration in relation to adult males to calculate mean overall effect sizes of these groups across populations. Median date of first snowfall >10 cm, mean normalized difference vegetation index (NDVI) during the growing season (April–September), and the interaction of these 2 parameters best predicted observed mean den entrance dates for both species.

Number of months which on average receive snow, mean NDVI, and the interaction of these 2 parameters best predicted observed den duration at the same scale. Observed variability among populations from expected den chronology was best predicted by the variability of parameters predicting entrance and duration. Also, greater variability in den chronology and explanatory parameters was observed in southern portions of species' ranges and for populations in coastal habitats. Examining population level variation of reproductive groups, we found that across all populations and both species, parturient females entered dens earlier and denned longer than non-parturient females, followed by adult males. We suggest the selective pressures influencing den behavior of American black bear and brown bear are a combination of factors driving primary production and foraging efficiency, and that relaxation of these selective pressures across species' distributions promotes ecological plasticity. Within populations we found that variation among reproductive groups does occur, and appears a result of variation in energetic demands due to parturition and Kleiber's law. Quantification of multilevel ecological responses by species experiencing varying degrees of selective pressures may aid in predicting and planning for consequential responses to climate change in these and other species.

Den Entry Behavior in Scandinavian Brown Bears: Implications for Preventing Human Injuries

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Encounters between Scandinavian brown bears Ursus arctos and humans that result in human injuries and fatalities typically coincide with den entry in October/November and commonly occur in the presence of a den. Our aim was to determine when bears arrive at their dens, identify potential predictors of the timing, and document behavior and activity associated with this period and how this might explain the increased risk of bear-caused human injuries documented in this period. We analyzed location and activity data from GPS collared brown bears in south-central Sweden and used the combination to identify potential start of denning and the location of potential den sites and confirmed den sites via field visits. We used activity data to determine the start of hibernation level activity (inactivity at a site) and location data to investigate movement prior to hibernation. We used generalized linear mixed models to investigate the influence of demography and infrastructure on timing of arrival at the den, time spent at the den site before hibernation, and den abandonment. Activity data was analyzed using statistical process control to document reduction in activity and how this related to movement prior to hibernation. Bears arrived at their den sites from 6 October until 1 December. Timing varied with reproductive category and bear age, and between years. Younger bears spent longer time in their den area before hibernation than older bears. We detected some effect of human infrastructure on timing of den entry; however, these patterns may be a result of social organization factors that influence den selection. Half of all bears reduced their activity significantly on average 2169 m from and 1.8 days before arriving at the den area. The other half reduced their activity after arriving at the den area. The latter bears took longer time to reach hibernation activity levels, but there was no difference in start of hibernation activity between the 2 groups. Bears also appeared to be more sensitive to disturbance in this period, with higher den abandonment rates than later in winter, particularly for males and bears that had not visited their den sites before den entry. Den entry occurred over a long period, with high variability and poor predictability of its timing. Restrictions on hunting or other recreation activities that may disturb bears and expose people to greater risk of injury by bears would therefore probably be both impractical and ineffective. Our findings can be used to educate hunters about bear behavior at this time of year. Many associate dens with increased risk of a bear responding aggressively to disturbance, but our results indicate that other behavioral and possibly physiological changes in this period also may be involved.

Yes, No, Maybe: Den Selection by Brown Bears in the Southeastern Part of the Eastern Romanian Carpathians

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Denning activity and den characteristics of brown bears *(Ursus arctos)* were studied in the Southeastern part of the Eastern Romanian Carpathians during 2010–2012. Within the framework of a Life Nature project targeting the conservation of bears in Vrancea, Covasna, and Harghita counties, 58 dens were identified, measured, and monitored. Thirty-seven (64%) dens in the study area were actively used by bears during the monitoring period. Bears mainly selected rock cavities (51.4%) exposed to the Southwest (37.8%) and situated at altitudes between 800 and 1200 m (65%). Against other factors like the distance to road, the type of den and the slope gradient, the distance to water played the most decisive role. About 60% of dens were located less than 250 m from a water source. To assess the factors' relevance in using a den, we applied logistic regression. Actively used dens were in average closer to a water source (xDiff = 158.35 m) than unused hollows (B = −0.002, SE = 0.001, $P = 0.040$, 95% CI for EXP(B) = 0.996–1.00). Additionally, 15 utilized dens were monitored by video cameras equipped with motion sensors and recording tools mounted inside the cavities to measure temperature and relative humidity so that precise information was obtained about the bears' activity during the denning period and the dynamics of the ambient parameters inside the dens.

Microclimatic parameters in the dens indicated that the thermal amplitude and the relative humidity values were linear, being approximately constant throughout the winter periods. Our results can be useful to prevent disturbance of den sites during forest exploitation and adjusting logging management according to living demands of bears.

Session 6
REPRODUCTION & PHYSIOLOGY

TBA

Sequential Ovulation and Fertility of Polyestrus in American Black Bears (*Ursus americanus*)

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Among seasonally polyestrous species, it is widely assumed that only the last of sequential estruses is conceptive, because once pregnant, subsequent follicular development would cease due to active corpora luteal (CL) function. American black bears (*Ursus americanus*), however, have relatively inactive CL during delayed implantation. Therefore, we hypothesize that conception can occur during any of the estruses of a polyestrous female, and that this process is independent of pregnancy. Twelve semi-free ranging female black bears were monitored for vulvar swelling, and focal sampling and continuous recording were used to document mating behavior. During each separate estrus (determined by vulva score and behavior), two different males were allowed to breed the females and then removed, and paternity of offspring was established using

PCR with two microsatellite markers and electrophoretic separation. Of the conceptive polyestrous females, half were impregnated during the first estrus while the other half were impregnated during the second/last estrus ($t = 0.325$, df = 11, $P = 0.376$). Laparoscopy confirmed the presence of both a corpus hemorrhagicum (recent ovulation/estrus) and a well-developed CL (older ovulation/estrus) in the ovaries of a polyestrous female. The combination of paternity and anatomical data strongly indicates both estruses are fertile. In addition, we are examining the factors influencing paternity success, including age and size of males, mate order, timing of ovulation, and amount of ejaculate. These results give better insight to the complex behavioral and physiological breeding habits of bears.

Physiological Response of Free-Ranging American Black Bears to Habitat Features in a Highly Fragmented Landscape

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Understanding an animal's physiological response to stressors can yield powerful insights for subsequent management and conservation, particularly for species living in marginal or heavily disturbed habitat. However, few studies have successfully obtained continuous physiological data in free-ranging large mammals. During 2009–2012, we outfitted 8 American black bears (*Ursus americanus*; 11 bear-years) in northwestern Minnesota with GPS collars and subcutaneously-implanted cardiac monitors (Reveal XT, Medtronic, Inc.). Northwestern Minnesota is particularly well suited for studying anthropogenic stressors because it is comprised of small forest fragments (<20% forest coverage) situated within an expansive agricultural matrix. The implanted cardiac monitors recorded heart rate continuously, and provided daytime and nighttime averages. We aimed to understand the relationship between energetic costs (as measured by cardiac response) and bear movements. We also examined how this relationship varied with natural and anthropogenic landscape features. We employed mixed models with a random effect for a given individual, in order to account for temporal autocorrelation and pseudo-replication. The best fitting model for estimated energetic output included significant positive effects for movement rate, crop use, road crossings, degree of habitat fragmentation, temperature, and relative cloud cover. We also observed strong relationships between energy expenditure and several categorical variables: season, time of day (day or night), and gender. Movement rate was significantly affected by many of these same covariates. Although use of crop fields was negatively associated with movements, it was positively associated with heart rate. That is, bears in crop fields elicit higher-than-expected heart rate, likely due to the stress of foraging in a nonnatural area, with human scents and often several other bears in proximity. We are developing a state-space model that aims to estimate the true states for movement and energy expenditure (based on heart rate) to better discern whether the covariates have a larger influence on movement or energy expenditure.

Session 7
MANAGEMENT I

Trap Array Configuration Influences Estimates and Precision of Black Bear Density and Abundance

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Estimating density of wildlife populations is essential for making informed conservation and management decisions. Capture-recapture methods using noninvasive sampling techniques are now standard for estimating abundance of carnivores. However, individual movements and edge effects often hinder reliable population estimates for low density, wide-ranging carnivores. Advances in spatial models treat both density and detection parameters explicitly as a function of trap distribution and animal movements. We used DNA-based encounter history data to estimate density and population size of American black bears (Ursus americanus) in south central Missouri from 2 sampling designs. In 2011, we distributed 378 hair snares proportionate to the number of historical bear sightings located within 100 km^2 cells. In 2012, we established 403 hair snares in five 210 km^2 arrays with 2.6 km^2 cells, each with one snare. Microsatellite marker analysis of hair samples from snares revealed 27 and 90 individuals identified in 2011 and 2012, respectively. Detections were 5 times greater using the 2012 design, although about 60% of individuals were not recaptured in each year. We estimated density and abundance with spatially explicit capture-recapture models using maximum likelihood and model selection theory. Density estimates were 0.7 (SE = 0.2) and 2.5 (SE = 0.5) bears per 100 km^2 in 2011 and 2012, respectively. Population size for each area of integration was 87 (SE = 28) and 252 (SE = 50) bears. Using multiple arrays with closer trap spacing resulted in a twofold decrease in coefficient of variation of parameter estimates. We illustrate that spatial sampling design can greatly affect parameter estimates and must be appropriate to a species' spatial ecology, despite advantages of spatially explicit models. For populations with unknown distribution in a fragmented landscape, we recommend using multiple arrays with intensive sampling to maximize detections while maintaining sufficient spatial coverage.

Brown Bear Predation on Semi-Domestic Reindeer in Scandinavia and Its Mitigation

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Large carnivores are often in conflict with humans for space and resources. The increasing brown bear population in Sweden causes controversy, due to bear predation on livestock, especially on semi-domestic reindeer. As part of a national effort to mitigate the economic losses due to bear predation, we studied brown bear predation rates on reindeer calves in two Sami (i.e. indigenous reindeer herders) villages in northern Sweden, using a newly developed method of using proximity collars on 2585 reindeer and GPS collars on 24 bears.

Proximity collars send out a weak UHF signal that can be detected within a 100 m distance by the bears GPS collars which then instantly start frequent GPS positioning (~1 position per min) for one hour after last detection. These GPS positions are transmitted via satellite, which allows searching for carcasses at the bear's positions in the field within a few hours. Encounters between reindeer and bears created 1283 clusters where the bear had resided a minimum of 3 min within a radius of 30 m, which were searched within 41 hours after the bear left the site.

We found 335 calves and 18 adult reindeer killed by GPS-collared bears; 99.7% of the calves (334 of 335) had been killed from 1 May to 9 June. Both number of calves killed and predation rates peaked in mid-May. The bears killed on average 0.4 calves per day when on the calving grounds in the period from 1 May to 15 June (i.e., 11 calves per year). We detected large individual and annual variation among the bears in reindeer calf predation. Not all bears killed calves, and there was a clear relationship between the number of days the bear spent on the calving grounds and the number of calves killed. Bears that were documented killing calves killed on average 2 calves per day and 17 calves per year. There was no difference in predation patterns between sexes and age or reproductive categories of bears, probably due to low sample sizes. However, females with yearlings seemed to have the highest predation rates, whereas we did not document any females with cubs of the year that killed calves.

Using the estimated number of bears, their estimated predation rates, and documented calf loss from postpredation counts, we estimated that 60%–100% of the losses of calves on the calving grounds in these two Sami villages were due to bears. Killing of problem bears (i.e., individuals that are more prone to kill calves than other bears) probably would have little effect, because they are rare. Reducing the bear population on the calving grounds may save calves, but not more than proportional reduction of bears. Shooting bears to reduce predation on calves will have the greatest impact early in the season, if directed at females with yearlings. Effects decline sharply after 1 June. Calving in corrals may provide the greatest protection from depredation by bears, but is not sustainable in the long term and is not favored by the Sami reindeer herders.

Patterns of Black Bear Abundance in the North Cascades Ecosystem: Implications for the Role of Wilderness in Large Carnivore Conservation

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Recent advances in non-invasive research methods have facilitated less costly evaluations of bear populations across wide geographic ranges. Non-invasive hair-snagging and genetic tagging allow identification of species, sex, and genotype of individual bears without necessitating direct capture or observations. From 2008 to 2011 we deployed barbed wire hair-snag corrals to collect DNA samples from black bears (*Ursus americanus*) in the North Cascades Ecosystem (NCE) of Washington State. Using the genetic data, we examined the influence of habitat characteristics and human activities on bear abundance across heterogenous landscapes of the NCE. Bear abundance was positively associated with vegetative cover and overstory tree canopy closure classes with high potential for bear food production, consistent with the hypothesis that bear habitat use is nutritionally driven. After accounting for habitat variation, bear abundance was higher on national park lands where hunting is prohibited, but was the same in roaded-frontcountry and designated wilderness areas where hunting occurs. Our results challenge the assumption that roadless, wilderness areas serve as source areas or refugia for bears from anthropogenic pressures, and warrant a reevaluation of the role of designated wilderness in the conservation of large carnivore populations.

Session 8
MANAGEMENT II: METHODOLOGY

A Comparison of Andean Bear (*Tremarctos ornatus*) Densities Using Camera Traps at Waterholes and Bear Trails in the Tropical Dry Forest of Northwestern Peru

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The monitoring and management of species depends on reliable population estimates, and this can be both difficult and very costly for wide-ranging mammals such as the Andean bear (*Tremarctos ornatus*). Camera trapping and capture-recapture models have been widely used to obtain population estimates needed to guide management of large mammals. However, these techniques have rarely been applied to bears. To date there are no statistically rigorous density estimates for Andean bears anywhere in their range, which hinders conservation planning. As part of a long-term study, we present the first population and density estimate for Andean bears in the endangered seasonally dry tropical forest of northwestern Peru, using cameras traps and capture-recapture analysis. We estimated population size and density using 2 different strategies for collecting camera trap data. Between May 2012 and January 2013 we carried out 2 camera surveys by installing pairs of Reconyx cameras at 40 points along bear trails (3155 camera days) and at 9 permanent waterholes (1350 camera days) throughout the field site. Bears were identified at waterholes (n = 15) and along bear trails (n = 14) using their unique facial markings.

We calculated population estimates using the standard Mh Jackknife closed-population capture-recapture model. Estimates were 17± 2.59 (CI: 14–27) from the trail data and 22 ± 5.8 (CI: 17–44) from the waterhole data. Based on what we know about the population from a 5-year observation study (i.e., bears seen in the study area before and after the sampling period), approximately 23 adult and sub-adult bears could have been detected in the study area during the time of the surveys; therefore, the estimate from the trail data seems low and the estimate from the waterhole data is reasonable. This could be related to seasonal changes of bear activity throughout the birthing season (July–September) where female bears with neonates spend more time in their dens.

The study area consists of roughly 250 km^2 of suitable bear habitat. We used this area, instead of a buffer around all cameras, to estimate bear density: 6.8 ± 1.2 bears/100 km^2 (CI: 5.6–10.8) from the trail data and 8.8 ± 2.4 bears/100 km^2 (CI: 6.8–17.6) from the waterhole data.

The use of camera traps at waterholes seems to be a reliable method for our study area and is less expensive and requires less effort than other sampling designs. Our data show that camera traps can be used to generate reliable population estimates for Andean bears, and that the dry forest is indeed important habitat for this species and should be a priority for conservation.

Mapping the Habitat Suitability of Asiatic Black Bear in China Using Species Distribution Models

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Habitat loss and fragmentation are among the major threats to many endangered species. One step in slowing the decline of species that are facing such threats is accurately mapping the species' current distribution. To estimate the potential habitat suitability of Asiatic black bear (*Ursus thibetanus*) of China, we will use a species distribution model intergrating presence-only data and environmental variables. We also aimed to assess the fragmentation of habitat and identify the potential dispersal corridors for the species. We will construct Maxent models with presence-only data of Asiatic black bear collected from systematic fieldwork, published references, and current monitoring programs of nature reserves. Bioclimatic variables were derived from WorldClim and 1:1,000,000 maps. The performance of models will be evaluated by 10-fold-cross validation. Jackknife tests will be used to interpret the relative contribution of each variable. We will use least-cost path analysis to estimate the dispersal paths for Asiatic black bear in a fragmented landscape. We recommend corridors be established across mid-elevation areas with low human density and sufficient forest coverage. The current distribution of Asiatic black bear is predictable based on suitable forest and the presence of protected areas that coincide with areas of low human density. Although the current distribution is disjointed with isolated populations, there is the potential for corridors between populations if action is taken to preserve current forest cover. The map of habitat suitability will help us to clarify the large uncertainty of current distribution range of Asiatic black bear in China.

Evaluation of Bear Baiting on National Park Service Lands in Alaska: A Conservation Ethics Approach

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Black bear (*Ursus americanus*) baiting has long been allowed on some National Park Service Lands in Alaska, and brown bear (*Ursus arctos*) baiting was authorized for several Alaskan National Preserves in 2013. Evaluation of harvest data from 1992 to 2010 indicates that very few black bears have been harvested over bait over this time period (<2/year) with most of the harvest in and around Wrangell-St. Elias National Park. Only 3 bears across this time period were taken by local rural residents, a preferred user group under the legislation that created many of these NPS units. There is neither a biologically significant effect from this singular form of harvest nor a recent history of significant use by local residents; thus, this issue should not be characterized as one of conservation or subsistence opportunity. Regardless, the decision of whether or not to allow these practices on NPS lands remains. NPS is governed by specific policy mandating natural processes and natural behaviors be maintained. I used the formal field of conservation ethics, specifically argument analyses, to develop a logic model to provide insights to managers charged with implementing policy. Primary premises of our analyses included the desire to avoid conditioning bears to human food as food-conditioned bears tend to be more dangerous to humans and are more likely to be killed through means other than hunter harvest. The results of these analyses conclude that, in general, bear baiting should use only locally and naturally occurring food items (recognizing this would largely make the practice of baiting ineffective). Relative to NPS lands, if it is assumed that existing policies are sound, bear baiting should not be allowed as they explicitly alter both natural processes and behaviors.

Methods to Estimate Distribution and Range Extent of Grizzly Bears in the Greater Yellowstone Ecosystem

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As debate over grizzly bear (*Ursus arctos*) delisting under Federal ESA persists, the distribution of the Greater Yellowstone Ecosystem grizzly bear population has expanded into areas unoccupied since the early 20th century. Up-to-date information on the area and extent of this distribution is crucial for federal, state, and tribal wildlife and land managers to make informed decisions regarding grizzly bear management. The most recent estimate of grizzly bear distribution (2004) utilized fixed kernel density estimators to describe distribution. This method was logistically cumbersome and excluded observations of unmarked bears. Our objective was to develop a technique to generate an estimate of grizzly bear distribution that would allow for the use of all verified grizzly bear location data, as well as provide the simplicity to be updated more frequently. We placed grizzly bear locations from 1990–2004 and 1990–2010 onto a 3 × 3 km grid and used nearest neighbor analysis and ordinary kriging to develop a predicted surface of grizzly bear distribution. We compared the area and extent of the 2004 kriging surface to the previous 2004 effort and evaluated changes in grizzly bear distribution from 2004 to 2010. The 2004 kriging surface was 2.4% smaller than the previous fixed kernel estimate, but represented the data closely. Grizzly bear distribution increased 38.3% from 2004 to 2010, with most expansion in the northern and southern regions of the range. This technique can be used to provide a current estimate of grizzly bear distribution for management and conservation applications.

Use of Stable Isotopes to Investigate the Foraging Behavior of American Black Bears in Yosemite National Park

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Stable isotope analysis is an emerging method in wildlife research. Stable isotopes are commonly used to reveal community trophic structure, to elucidate migratory patterns, and to estimate the diets of animals. For this presentation, Dr. Hopkins will demonstrate the use of stable isotopes to answer questions related to the foraging behavior of American black bears in Yosemite National Park. Specifically, he will show how he used isotopes (1) to detect dietary specialists—bears that forage on human foods, (2) to estimate the diets of these bears over the past century, (3) to evaluate the park's human-bear management program, and (4) to investigate mother-offspring social learning.

Session 9
POLAR BEARS I

Summertime and the Living is Not Easy: Polar Bear Nutritional State During the Melt Season

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During summer, polar bears often fast and rely on stored energy. Bears spending the summer on shore may have access to terrestrial food; in Alaska, this includes whale carcasses from subsistence harvest. Bears spending the summer on sea ice may continue hunting seals. However, recent sea ice loss is forcing bears to remain on shore longer, and carrying bears on sea ice to deep water where seal density is likely low. These trends can cause increasing nutritional limitation during summer, a mechanism which may ultimately lead to population decline. We tested the hypothesis that summer nutritional state differs between bears on shore and bears on ice. From 2008–2010, in April/May, August, and October, we sampled bears on shore (northern coast of Alaska) and on ice (Southern Beaufort Sea). As expected, preliminary analyses indicate serum cortisol was lowest in April/May, suggesting more bears were fasting in August and October. However, in October, bears on ice had lower serum urea:creatinine, higher serum non-esterified fatty acids, and enriched skeletal muscle $\square^{15}$N. These data suggest bears on ice were in a fast (potentially including extensive oxidation of endogenous protein) longer than bears on shore. Pending analyses will expand these results and investigate implications for population persistence. Principal funding was obtained from the U.S. National Science Foundation (0732713).

Cortisol in East Greenland Polar Bear Hair: Results and Applications

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Polar bear hair was recently found to be a feasible matrix for measuring cortisol levels, reflecting the longer-term physiological stress of the individual. This presentation will provide an overview of cortisol levels measured in East Greenland polar bears (1892–2009) in terms of temporal trends, and correlations with contaminant and climate indicators: cortisol concentration was independent of sex and age, and was found at significantly higher concentrations in historical hair samples (1892–1927) relative to recent ones (1988–2009). A linear, decreasing time trend was found in cortisol concentration of the recent samples. Persistent organic pollutant (POP) loads measured in polar bear subcutaneous adipose tissue were found to be primarily negatively correlated with the hair cortisol levels. POP loads measured in the hair samples themselves, however, did not show the same correlation, possibly due to different biological factors relating to polar bear hair. In addition, the North Atlantic Oscillation (NAO) climate index was found to explain approx. 77% of the variation in hair cortisol values, indicating increasing levels of stress hormones in the bears during warmer years. Furthermore, investigations of the multivariate relationship between hair cortisol, whole blood circulating thyroid hormone, and adipose tissue POP levels indicated that the hypothalamic-pituitary-adrenal (HPA) axis of the bears was likely to be affected by POPs and that the association between the POPs and cortisol may be linked with the hypothalamus-pituitary-thyroid (HPT) axis.

Variation in the Response of an Arctic Top Predator Experiencing Habitat Loss: Feeding and Reproductive Ecology of Two Polar Bear Populations

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Polar bears (*Ursus maritimus*) have experienced substantial changes in the seasonal availability of sea ice habitat in parts of their range, including the Beaufort, Chukchi, and Bering Seas. In this study, we compared the body size, condition, and recruitment of polar bears captured in the Chukchi-Bering Seas (CS) between 2 periods (1986–1994 and 2008–2011) when declines in sea ice habitat occurred. Additionally, we compared metrics for the CS population 2008–2011 with those of the adjacent southern Beaufort Sea (SB) population where loss in sea ice habitat has been associated with declines in body condition, size, recruitment, and survival. We evaluated how variation in body condition and recruitment were related to feeding ecology. Comparing habitat conditions between populations, there were twice as many reduced-ice days over continental shelf waters per year in 2008–2011 in the SB than the CS. CS polar bears were larger and in better condition, and appeared to have higher reproduction than SB bears. Although SB and CS bears had similar diets, twice as many bears were fasting in spring in the SB than the CS. Between 1986–1994 and 2008–2011, body size, condition, and recruitment indices in the CS were not reduced despite a 44-day increase in the number of reduced-ice days. Bears in the CS exhibited large body size, good body condition, and high indices of recruitment compared to most other populations measured to date. Higher biological productivity and prey availability in the CS relative to the SB, and a shorter recent history of reduced sea ice habitat, may explain the maintenance of condition and recruitment of CS bears. Geographic differences in the response of polar bears to climate change are relevant to range-wide forecasts for this and other ice-dependent species.

Behavioural and Autonomic Thermoregulation in Polar Bears (*Ursus maritimus*)

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Polar bears have adapted to the arctic environment by effective thermal insulation. Their thermoneutral zone (TNZ), defined as the range of ambient temperatures (TA) within which regulation of body temperature (TB) is achieved without changes in metabolic rate, is relatively wide and reflects temperatures occurring in the arctic. According to literature, polar bears maintain a constant TB at TA between –30 and 5 °C. Below the lower critical temperature (TLC) and above the upper critical temperature (TUC) an endotherm must increase its metabolism to maintain TB, which is energetically unfavourable in the long term. With increasing temperatures due to global warming, the upper critical temperature of polar bears might be exceeded during summer. The purpose of the study was to investigate the effect of different ambient variables on thermoregulatory mechanisms of polar bears and to determine to which degree behavioural regulation complements autonomic mechanisms to keep energy expenditure low. The study took place in European zoos including ten adult polar bears. Thermography, a non-invasive method that detects heat dissipation via the body surface, was used to detect body surfaces specialized for heat dissipation. Infrared measurements were taken at TA between 0 and 20 °C. To assess behaviours which might contribute to thermoregulation, behavioural observations were conducted by instantaneous scan sampling at TA ranging from –2 to 35 °C. Activity, body posture, selection of substrate, choice of shady resting places and occurrence of panting were recorded every 60 seconds for a total of 1000 observation hours. Simultaneously, TA [°C], humidity [%], wind speed [km/h] and solar radiation [W/m^2] were recorded four times per hour. The assumption that polar bears are able to dissipate heat over specialized body surfaces in the shoulder regions, so-called thermal windows, was confirmed. However, behavioural data revealed that energy saving behaviours occurred before heat dissipation, which would increase the physiological costs, becomes necessary. Activities, such as explorative behaviour, significantly decreased above 5 °C,

the TUC of polar bears. A positive correlation between TA and resting in a most extended body position, that helps to dissipate excess heat, was found. Choice of an adequate microclimate, such as shady places or staying in water, was positively correlated to TA. The results provide a basis for the evaluation of consequences of a warming climate on activity patterns and energy expenditure in polar bears under changing conditions. With fewer fat reserves due to longer ice-free periods in summer, additional physiological costs for thermoregulation could compromise their energy budget even more. These findings might help to estimate to which degree polar bears are capable to adjust to differing climate conditions and under which conditions their adaptability is exceeded.

Beaufort Sea and Viscount Melville Region Sea Ice-Polar Bear Colloquium: Recommendations to Researchers and Management

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This paper will provide a summary of the proceedings from a Sea Ice-Polar Bear Colloquium held in February 2011 organized by the Joint Secretariat – Inuvialuit Settlement Region. This colloquium was held to examine the following question: What are the anticipated effects of climate change on sea ice, polar bears, and their prey in the Beaufort Sea and Viscount Melville region? The first half of the colloquium included presentations from a sea ice scientist, a polar bear biologist, and seal biologists regarding the state of knowledge of trends of sea ice, polar bear and seal populations, and their distribution in the Beaufort Sea and Viscount Melville Sound. Presenters included eminent scientists from University of Manitoba, GNWT, University of Alberta, United States Geological Service, Canada's Department of Fisheries and Oceans, and the Canadian Ice Service. The second part of the colloquium involved an open discussion with all the presenters and participants to explore the positive and negative effects of climate change on the interrelationship between sea ice and polar bears and their prey. The discussion also addressed taking stock of the state of knowledge for these regions and the critical actions for short and long term as pertaining to sea ice and polar bear research in the Beaufort Sea and Viscount Melville Sound. This paper will also provide the conclusion from the colloquium with respect to the future of polar bears with respect to climate change.

Effects of Chemical Immobilization on the Movement Rates of Free-Ranging Polar Bears

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The capture and handling of free-ranging animals is an important tool for wildlife research, conservation, and management. Although field studies using less invasive methods (e.g., aerial surveys) can provide insights into the abundance of populations, the physical capture, marking, and recapture of individual animals remains an important approach for population assessment and may be the only means of collecting certain types of biological samples, measurements, and demographic information. However, live capture may also expose individual animals to risk of injury, impairment, or mortality. For populations of conservation concern, the effects of handling must be known and weighed against the conservation benefit of live capture programs. The polar bear *(Ursus maritimus)* is a species of conservation concern throughout its range and physical mark-recapture techniques have formed the basis of polar bear research and harvest management for decades. We examined movement patterns of polar bears post-capture to measure their recovery from

chemical immobilization and determine whether captured bears experienced prolonged effects that would affect individual fitness. Adult female (n = 61) and juvenile (n = 13) polar bears in 3 Canadian subpopulations were captured during the course of other studies using a combination of tiletamine hydrochloride and zolazepam hydrochloride delivered via remote injection from a helicopter. Bears were fitted with satellite-linked global positioning system collars and we used 3 individual-based metrics to assess their recovery from immobilization: (1) time to move 50 m; (2) time to move 100 m; and (3) time to reach a baseline movement rate threshold (km/day) derived from each individual's movements in a fully recovered state (i.e., 30–60 days post capture). There were no differences in recovery rate metrics across years, age classes, or between females with cubs of different ages. When compared across subpopulations, only the time to move 50 m differed, being shortest in the southern Beaufort Sea. Bears captured on land during the ice-free period in western Hudson Bay and Foxe Basin were more variable in their response to capture than were those handled on the sea ice of the Beaufort Sea, but in all 3 areas, bears showed gradual increases in movement rates. Movement rates indicative of recovery were often reached 48 h after capture and 69% of bears (51/74) appeared to be fully recovered in about 3 days. Consistent with preliminary work on chemical immobilization of polar bears, there was no relationship between drug dose and rate of recovery. Our results indicated that polar bears captured in different locations, seasons, and life history stages recovered predictably from chemical immobilization in a timeframe that is unlikely to affect individual fitness. Although each step in the capture process (e.g., pursuit, darting, chemical immobilization) presents some risk to individual polar bears, our results provide further evidence that these risks are understood and manageable.

Session 10
MANAGEMENT III: HANDLING PROCEDURES

Comparing the Use of DNA Hair Snares, Live Capture, and Trail Cameras for Obtaining Black Bear Population Estimates in Southwestern Idaho

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Black bear (Ursus americanus) research was conducted in arid southwest Idaho from 2007–2013. The primary objective of this study was to obtain and compare population estimates from DNA hair snares, live-trapping, and trail cameras. The three population density estimates will be analyzed and compared for cost, ease of use, and reliability of results. DNA was collected from 4 different populations of bears in Southwest Idaho from 2007 through 2011. Through 2011, 422 individual black bears were identified. Preliminary modeling generated black bear density estimates of approximately 0.75 bears/sq. mile in the heavily hunted study area and 1 bear/sq. mile in lightly hunted area. Density estimates will be developed for the mark/recapture data for the live-capture effort where we marked 39 individual bears from 2010–2012. Trail cameras were set in the study area during the summer of 2012 and 2013 to develop a population estimate using the mark-resight technique. This paper will review the effectiveness of the trail camera mark-resight technique for obtaining black bear density estimates and compare it to the other better known techniques.

Density Estimation of Brown Bear Population by Three Noninvasive Methods in Artvin, Turkey: Implications for High Density

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Population size and density of brown bears in Turkey are vague due to lack of proper surveys owing to low institutional and personal capacities, security problems at remote and rugged areas, secretive and nocturnal nature of bears with low detectability. Lack of reliable estimates leads to problems in decision making. To fill this data gap for a focal area known for human-wildlife conflict and game hunting in Yusufeli district of Artvin, we applied three filed-based methods: mark-resight and Fcoy based on field observations and minimum number of bears identified from camera trap photos. Mark-resight analysis were based on data obtained from 10 camera trap stations positioned in 2 × 2 km quadrats in 48 km^2 between June and October 2011 in two seasons: before and after 15th August. In addition telemetry data obtained from 7 collared bears (5 males, 2 females) for 2009–2011 were used for field observation and animal equivalent to calculate sighting frequency. We also recorded camera trap sighting cases by sampling with replacement and applying standard protocols (e.g. leaving 24 hours between consecutive bear events and marked individuals). Bear population was supposed to be geographically open whereas demographically closed during the 10 weeks of 2 resighting periods. Fcoy analysis was based on 15 days of observation in 61 km^2 and an additional 5 days of observation at boundaries between May and June for 2008–2011 years. Minimum distance was kept as 2 km. Fcoys were differentiated from each other based on distance between sightings, family group descriptions, and dates of sightings. Minimum Fcoy was estimated by the use of Chao2 estimator to estimate independent bear population size "N_{Est} = F + M + Three years" formula was used excluding cubs. Finally, bear images in 2011 were differentiated by using their marks, cubs, and skin color patterns from camera trap photos. All estimates were converted to the number of independent bears per 100 km^2. Density estimated by Fcoy is found to be 24.50 ± 1.74 / 100 km2 as an average of consecutive years. 72 bear images of 35 sightings of unmarked bears and 10 resighting of marked bears were obtained in the first mark-resight period. Density was calculated as 23.90 ± 2.66 /100 km^2. In the second period 99 bear images of 12 marked bears and 50 unmarked bears were recorded. Density for that autumn period was found to be 26.42 ± 2.56 /100 km^2. At least 19 bears were differentiated from photos in 2011 and population density was about 31.15 bears/100 km^2. Although all methods had internal and external biases, all results implied that brown bears in Artvin display a high population density of 23–31 individuals /100 km^2. We identified the possible reasons for high density as locally high NDVI value areas (productive croplands and orchards) followed by bears, hard masts, exclusive female home ranges around productive croplands, and highly tolerant people towards to bears.

Evaluation of the Effects of Helicopter-Based Capture and Collaring on Movement Rates and Body Condition of Polar Bears

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An important aspect of all wildlife research is understanding the potential impacts of research methods on the species of interest. In this study, we examined the potential effects of helicopter-based captures on movement rates, body condition, and potential reproduction for polar bears in the southern Beaufort Sea. Since 1985, over 1000 bears have been captured as part of a long-term monitoring program with nearly half being captured more than once. All captures were conducted from a helicopter by administering a dart containing Telazol. We will present results comparing the body condition of bears captured once versus those captured multiple times controlling for other factors that can affect condition. Additionally we will compare litter size, litter mass, apparent cub survival, and hematological and physiological profiles between bears with different capture histories. We will identify the rates and distance of movement and activity during the hours and

days post-capture compared to norms for bears during the same season. Lastly we will examine the fates of bears wearing collars versus those that were not fit with satellite collars. Preliminary results suggest that body condition and cub size and survival did not differ between bears captured once and those captured multiple times. Movement rates appeared to return to normal after approximately 96 hours.

An Agency Manual for Capture and Handling of Black Bears Involved in Human–Bear Conflict

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When capturing and handling wild animals, one of the goals for any wildlife manager or researcher should be safety for the animals and personnel while maintaining an efficient and professional work environment. Often times the safest and most appropriate methods, ideas, and techniques for achieving this goal are not shared among professionals, resulting in an ongoing environment of "learning the ropes" or "reinventing the wheel." In an effort to promote communication and collaboration, we provide a draft field manual for agency biologists and officers to use for when responding to human–black bear conflict. The manual includes topics such as understanding bears and bear encounters; ideas and techniques for safely capturing and handling black bears; modifying culvert traps and leghold snares to avoid common injuries; marking and radio-collaring; determining age; releasing bears; data collection; and database management. We recognize that critical topics such as immobilization delivery systems, legal responsibilities associated with chemical immobilization (such as DEA compliance, drug usage, documentation, and storage), drug types, drug effects, and proper dosages can vary by jurisdiction and are therefore are not covered in detail throughout this manual (although they are presented elsewhere at this conference). It is our hope that over time, other agency staff can review and contribute to this manual, and we can work towards an adaptive interagency document that is constantly being updated to promote safety, consistency, efficiency, and professionalism.

Immobilization of Grizzly Bears with Dexmedetomidine, Tiletamine, and Zolazepam

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Safe and effective immobilization of grizzly bears (*Ursus arctos*) is essential for research and management. Fast induction of anesthesia, maintenance of healthy vital rates, and predictable recoveries are priorities. From September 2010 to May 2012, we investigated these attributes in both captive and wild grizzly bears anesthetized with a combination of a reversible α2 agonist (dexmedetomidine, the dextrorotatory enantiomer of medetomidine) and a nonreversible NMDA agonist and tranquilizer (tiletamine and zolazepam, respectively). A smaller than expected dose of the combination (1.23 mg tiletamine, 1.23 mg zolazepam, and 6.04 μg dexmedetomidine per kg bear) produced reliable, fast ataxia (3.7 ± 0.5 min, ±SE) and workable anesthesia (8.1 ± 0.6 min) in captive adult grizzly bears. For wild bears darted from a helicopter, a dose of 2.06 mg tiletamine, 2.06 mg zolazepam, and 10.1 μg dexmedetomidine/kg produced ataxia in 2.5 ± 0.3 min and anesthesia in 5.5 ±

1.0 min. Contrary to previously published accounts of bear anesthesia with medetomidine, tiletamine, and zolazepam, this combination did not cause hypoxemia or hypoventilation, although mild bradycardia (<50 beats per min) occurred in most bears during the active season. With captive bears, effective dose rates during hibernation were approximately half those during the active season. The time to first signs of recovery after the initial injection of dexMTZ was influenced by heart rate ($P < 0.001$) and drug dose ($P < 0.001$). Intravenous (IV) injection of the reversal agent, atipamezole, significantly decreased the recovery time (i.e., standing on all four feet and reacting to the surrounding environment) relative to intramuscular injection. Recovery times (25 ± 8 min) following IV injections of the recommended dose of atipamezole (10 µg/µg of dexmedetomidine) and half that dose (5 µg/µg) did not differ. However, we recommend use of the full dose based on the appearance of a more complete recovery. Field trials confirmed that the dexMTZ + atipamezole protocol is safe, reliable, and predictable when administered to wild grizzly bears, especially during helicopter capture operations.

Immobilization of Wyoming Bears Using Carfentanil and Xylazine

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Seven grizzly (*Ursus arctos*; 4 male, 3 female) and 3 black (*U. americanus*; 2 male, 1 female) bears caught in culvert traps or leg snares were immobilized in northwestern Wyoming with carfentanil and xylazine at doses respectively of 0.011 ± 0.001 and 0.12 ± 0.01 mg/kg for grizzly bears and 0.014 ± 0.002 and 0.15 ± 0.04 mg/kg for black bears. These drugs were antagonized with 1 mg/kg naltrexone and 2 mg/kg tolazoline. Induction and recovery times respectively for grizzly bears were 4.3 ± 0.5 and 7.1 ± 0.8 min and 5.2 ± 0.4 and 9.1 ± 2.2 min for black bears. Inductions were smooth and uneventful. Recoveries were characterized initially by increased respirations followed by raising of the head which quickly led to a full recovery with the bears recognizing and avoiding humans and moving away and maneuvering around obstacles. All bears experienced respiratory depression, which did not significantly improve with supplemental oxygen based on pulse oximetry ($P = 0.56$). Rectal temperatures were normothermic. Carfentanil-xylazine immobilization of bears provided significant advantages over other drug regimens including small drug volumes, predictable inductions, quick and complete recoveries, and lower costs. Based on these data, both grizzly and black bears can effectively be immobilized with 0.01 mg/kg carfentanil and 0.1 mg/kg xylazine.

Capture, Handling, and Extraction of Black Bears in Dens: Techniques, Risks, and Recommendations

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Capture and immobilization of black bears (*Ursus americanus*) in winter dens is an important method for collecting data for estimating cub production and recruitment and investigating denning ecology and hibernation physiology. Furthermore, removal of adult females and cubs from winter dens is essential for reintroducing or augmenting populations using winter soft-release methods. Finally, winter capture may be an efficient means of replacing collars to maintain adequate sample sizes for monitoring or candidates mothers to which orphaned cubs could be fostered. Because winter capture and handling can be accompanied by additional risks such as cub abandonment and mortality of both adults and cubs, research and management personnel should carefully evaluate the need to employ winter capture methods. We present an overview of methods used to capture and handle black bears during the winter season in a variety of field situations including tree, rock, and ground dens. We discuss strategies for maximizing capture success while minimizing the potential hazards, suggest alternatives to winter capture, and identify information gaps.

Selective Foraging for Anthropogenic Resources by Black Bears: How Can This Knowledge Help Managers?

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Human-bear conflict is a growing concern in many human-dominated environments from urban areas to national parks. Anthropogenic resources such as garbage, bird feeders, fruit trees, and camping supplies are commonly identified as bear attractants and the root causes of conflict. Because these resources vary at a fine spatiotemporal scale, it is often challenging to quantify their availability and to understand their influence on bear foraging behavior and subsequently human-bear conflict. Here, we present results from two studies, one conducted in a national park and the other in an urban system, where we studied bear foraging patterns to better understand how bears selected resources and to inform conflict management. The first study was conducted in Yosemite Valley, Yosemite National Park, USA, where human-bear conflict has occurred for decades resulting in tens of thousands of dollars of damage annually from vehicle break-ins by bears. To better understand what vehicles were targeted by bears, we gathered information on the number and type of vehicles broken into by bears (use; n = 1111) from 2007–2010, and sampled the number and type of vehicles parked overnight in parking lots (available; n = 3766) from 2004–2005. We classified all vehicles as 1 of 9 types and determined that bears strongly selected minivans (use = 29% vs. availability = 7%). The second study occurred in Aspen, Colorado, USA, where human-bear conflicts are common. From 2007 to 2010, we monitored 21 GPS-collared bears and backtracked to 529 urban foraging (use) locations within 50 m of human development and within 24 hours of bears use. Around each use location, we sampled 5 random (availability) locations within a half-hour movement buffer. We modeled anthropogenic feeding as a function of covariates related to natural food production (e.g., % cover and fruit ripeness), human food resources (e.g., presence and secure status of trash containers, presence of anthropogenic fruit), and landscape characteristics (e.g., distance to riparian area, human density). Eighty-three percent of feeding events were related to anthropogenic sources, and anthropogenic resource selection was best explained by presence of trash containers, availability of ripe anthropogenic fruit, density of urban housing, distance from riparian areas and attributes of trash containers. In both study systems, reducing available anthropogenic foods offers a viable option for long-term conflict reduction, and knowledge about selective foraging by bears can help prioritize management efforts. In Yosemite, our results indicate targeting education at minivan drivers and vehicles carrying small children (the likely culprit causing messy vehicles that attract bears) can help optimize management effort. In Aspen our results indicate that attractant sites within areas of low to intermediate housing density and closer to riparian areas are higher priority areas for targeting management. Since bears selected for areas with trash bins whether secured or not, ensuring that such bins are truly bear proof and easily secured is critical. Collectively, the 2 studies demonstrate how understanding selective foraging behavior of bears in human-dominated environments can help direct conflict management efforts.

Session 11
BEAR SPECIALIST GROUP

THIS SESSION DOES NOT HAVE ASSOCIATED ABSTRACTS.

POSTER SESSION I
REPRODUCTION

Mortality of a Female Sloth Bear *Melursus ursinus* from Birth Complications

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We report the death of a gravid sloth bear in her cubbing den at the San Francisco Zoo. Birth complications generally are regarded as rare in ursids due to the size disparity between mothers and cubs. But uterine dissocia resulted in the mortality of the female and her fully developed single fetus. Our poster includes the necropsy report by a certified pathologist, a professional illustration, and a discussion of implications for captive bear managers.

Early Pregnancy Detection in the Giant Panda

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The female giant panda is a monoestrous, spontaneous ovulator and experiences obligate pseudopregnancy following ovulation. Pseudopregnancies are characterized by hormonal and behavioral changes indistinguishable from term gestation, making pregnancy diagnosis difficult. A further complication is the giant panda's variable period of embryonic diapause, leading to gestations differing by as much as 100 days. There is also some evidence that the species experiences a high incidence of pregnancy loss. Currently, 2 different methods are available for pregnancy detection in the giant panda. Ultrasonography is frequently used to successfully visualize the uterus, fetus, and placenta. However, this technique is capable of pregnancy diagnosis only during the last 20 days of gestation. Thermal imaging detects abdominal heat signatures indicative of pregnancy as early as halfway through gestation, before or at the time of implantation. Despite these useful techniques, until recently there was no method to diagnose pregnancy prior to mid-gestation. Planning for management of a pregnant female and preparing for possible hand rearing of a cub would be facilitated by the knowledge that conception had occurred. An early indication that conception had not occurred following mating or artificial insemination could enhance captive propagation efforts by allowing time within the breeding season to hormonally interrupt a pseudopregnancy and allow for another estrus. Previously, it has been demonstrated that the serum levels of the acute phase protein ceruloplasmin increase during pregnancy in humans and domestic dogs. This glycoprotein is responsible for binding 70–95% of circulating copper and is an important regulator of iron metabolism. Ceruloplasmin has also been reported tobe an important factor in angiogenesis, indicating a potential role inplacentation. A single report of the potential use of urinary ceruloplasmin measurement for pregnancy diagnosisin the giant panda (Willis et al. 2011) showed differences in protein profiles between known pseudopregnancies and term pregnancies in 4 female giant pandas. In the present study a modified urinary ceruloplasmin assay detected the protein in post-ovulation urine of 14 adult female giant pandas encompassing 25 reproductive cycles. Ceruloplasminlevels from 7 to 30 days after ovulation were diagnostic of conception, and further analysis beyond 30 days was not additionally informative. The relatively large sample size made possible the establishment of a critical value of ceruloplasmin activity indicative of conception (13.509 u of enzyme activity/mL per mg creatinine), which was calculated as the mean ceruloplasmin level of known pseudopregnanciesplus 2 standard deviations of the mean. Five distinct categories of reproductive cycles were analyzed including known pseudopregnancy (n = 4), suspected pseudopregnancy (n = 7), known lost pregnancy (n = 4), suspected lost pregnancy (n = 3), and term pregnancy (n = 7), exhibiting mean ceruloplasmin levels of 9.72, 6.93, 21.14, 37.07, and 44.94 u of enzyme activity/mL per mg creatinine, respectively. These results indicate that conception may be reliably diagnosed within a month of ovulation

in the giant panda by measuring urinary ceruloplasmin by this method. However, it was not possible to predict a successful term pregnancy based on elevated ceruloplasmin levels, lending support to the assumption of frequent pregnancy loss in the giant panda.

Dates of Implantation and Parturition are Determined by Accelerometers and Body Temperature Loggers in Free-ranging Brown Bears

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Pregnancy and parturition are often difficult to detect in free-ranging wildlife, especially with species that give birth to altricial young in burrows or caves. Using accelerometry on GPS collars we recently detected that female brown bears are more active during the gestation than after parturition. We observed that the activity level in pregnant females (females which later appeared with cubs-of-the year) increased at the end of November, stayed elevated during gestation, and then suddenly dropped to a lower level at the end of January/beginning of February. Recordings of body temperature of brown and black bears during hibernation have demonstrated that the body temperature of pregnant females is higher (~37 °C) during gestation than during the rest of the denning period (32–34 °C). This suggested that the rise in activity during early denning period is related to implantation and the drop in activity in late winter is related to parturition. We implanted 10 female brown bears with abdominal temperature loggers (DST Centi, Star Oddi, Iceland) and equipped them with a dual-axis motion sensor mounted on GPS-GSM collar (Vectronic Aerospace GmbH, Berlin). The goal of this study was to determine wheter the patterns of activity and body temperature indicate implantation, gestation, and parturition. We defined the date of implantation and parturition as the first and last date of the sudden increase in body temperature in pregnant females during hibernation. Based on this definition, the mean date of implantation was 22 November, and the mean date of parturition was 18 January. The mean duration of gestation (from implantation to parturition) was 57 days. The activity levels correlated significantly with the body temperature during denning. The sudden rise and drop in body temperature occurred simultaneously with the rise and drop in activity. This finding enables us to retrospectively determine the dates of implantation and parturition for pregnant females with recorded activity data and/or temperature data.

Reproductive Parameters of Brown Bears in Hokkaido—Anatomical Observation of Reproductive Tracts and Individual Monitoring in the Field of Shiretoko National Park

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Conflicts between humans and bears, such as crop damage and intrusion into residential areas, are recently increasing in intensity in Hokkaido, Japan. For management of bears to mitigate these conflicts, we need information on bear biology and population dynamics. One of the biological factors that directly affects population dynamics is reproduction. Reproductive

efficiency is determined by multiple parameters, including age of sexual maturity, litter size, and reproductive intervals. To clarify these parameters of brown bears, we conducted 2 different studies in Hokkaido: (1) anatomical examination of reproductive tracts which had been collected from all of Hokkaido and (2) reproductive monitoring in individuals in the field of Shiretoko National Park (NP), situated in the eastern part of Hokkaido. Firstly, ovaries and uteri, collected by the Hokkaido Research Organization between 1997 and 2010, were macroscopically examined for the presence of corpora lutea (CLs) and placental scars (PSs) and histologically examined for corpora abicantia (CAs) with Weigert's stain. Secondly, we conducted individual identification of brown bears in the Rusha area of Shiretoko NP in Hokkaido and determined the reproductive history of each female bear (i.e., in which year and season the bear was accompanied by cubs or yearlings) from individual bear photos collected from 2006 to 2012. The number of CLs and PSs observed ranged from 0 to 4 and from 0 to 6, respectively. The youngest individual that had CLs was 3 and the mode was 4. Thus, sexual maturation of female Hokkaido brown bears occurred mostly at 4 years of age. Mean litter size of cubs was estimated at 1.62 from the mean of our observations (range 1–3, $n = 29$). Every female with cubs possessed PSs but no CL. As a result, these bears might be under lactational anoestrus as previously reported for several species of Ursidae. Almost all females with yearlings that died prior to September had PSs without CLs, but the ratio of females with PSs decreased after October and 2 out of 15 females had CLs. The estimated probability of existence of PSs after delivery was >0.95 on 14 April in females with yearlings and <0.05 on 15 August in females with 2 year olds. Among females without PSs or offspring, about 71% (12/17) had CLs, which means solitary females may ovulate at the rate of 71% with a 3-year interval in reproduction, and the average reproductive interval might be about 3.3 years if the remaining 29% of females reproduce in the 4th year. In contrast, individual monitoring for reproductive intervals in Shiretoko NP demonstrated that many females reproduced at 2-year intervals. The difference in reproductive intervals between the results from reproductive tracts which were collected from all of Hokkaido and individual monitoring in the Rusha area, which is an area of plentiful food resources, may come from the nutritional condition of the bears. In conclusion, we obtained some reproductive parameters of Hokkaido brown bears, such as age of sexual maturity, litter size, and reproductive intervals, and we suggest that the reproductive intervals of brown bears are flexible, which flexibility may be associated with food resources and nutritional condition.

Black Bear Den Ecology and Reproductive Success in Southwest Idaho

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Black bear (*Ursus americanus*) research was conducted in arid southwest Idaho from 2010 to 2013. The objectives of the study were to determine (1) population demographics and mortality rates in a heavily hunted population near Boise, Idaho; (2) den characteristics, reproductive rates, and winter condition of females and young; and (3) compare mark/recapture population density estimates using DNA hair snares, live-trapping, and trail cameras. This paper focuses on objective 2. Dens were visited during late February and March of 2011, 2012, and 2013. A total of 22 female dens were physically visited. Of those, 20 were of reproductive age and 7 had young, for a reproductive rate of 0.35. Of those 7 females producing young, the average litter size over the 3 years was 1.4. Females were scored for body condition over the 3 years and had an average score of 2 in 2011, 3.3 in 2012, and 2 in 2013. Five of the 6 females produced young in 2012. Females that were in poorest condition (<2 of 5) tended to not have young. Dens were normally under tree root wads, facing northerly, and at elevations that averaged 6103 feet. Cameras were placed at den sites to determine den emergence time and behavior.

Captive Andean Bear (Tremarctos ornatus) Litter Size, Litter Survival, and Sex Ratio at Birth

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Evolutionary theory predicts, and evidence supports, that a female's characteristics and environmental conditions, especially around the time of conception or parturition, may affect her investment in any given reproductive event (e.g., number of offspring per litter, offspring's survival, and offspring sex). While these effects may confer fitness benefits to the female in an evolutionary context, in a captive breeding context the changes in her litter size, litter survival, and offspring sex ratio could create a conservation challenge. Although there may be greater opportunity for adjustments in maternal investment among species with delayed implantation, such as bears, this is largely unstudied. Using data from captive facilities around the world, we describe litter size, litter survival, and birth sex ratio among captive Andean bears, a species considered vulnerable to extinction, to highlight the utility of studbook data for research and management.

We focus on the 350 litters for which the date of birth and mother are known. At parturition the average age of mothers (n = 100) was 9.29 years (±4.16 SD, 2.9–22.6, n = 328), and the average age of sires (n = 95) was 11.29 years (±5.8, 2.9–30.0, n = 331). There were an almost equal number of singleton (n = 164, 46.9%) and twin litters (n = 179, 51.1%), with few triplets (n = 7, 2.0%), yielding an average litter size of only 1.55 (±0.54). In 297 litters (84.9%) at least 1 cub survived for >1 day, but 53 litters (15.1%) were either stillborn or died during their first day.

A long-acknowledged male bias among captive litters in North America had been considered to have arisen by chance. The larger data set now available confirms this bias, and hints at causality. Litters include more males (n = 250, 46.0%) than females (n = 202, 37.2%) and cubs of unknown sex (n = 91, 16.8%). While we found a 50:50 sex ratio of cubs (as expected from chance) among litters born to wild-born females (64 males or 39.5%, 64 females or 39.5%, and 34 cubs of unknown sex, 21%), the litters born to captive-born females are skewed towards males: 186 males (48.8%), 138 females (36.2%), and 57 cubs of unknown sex (15.0%). Because most wild-born females were brought into captivity as cubs, this skew suggests that an extrinsic or intrinsic factor during the early development of female bears may have a long-lasting affect on the sex ratio of their cubs.

There are no published accounts of age at reproduction, litter size, litter survival, or litter sex ratio from wild Andean bears. Although some of the parameters we describe may not hold true for wild bears, they are of importance for plans to develop and maintain sustainable captive breeding populations. Given the desire to develop such programs for other bears, whose reproductive ecology is similarly unknown, we suggest that further analysis of studbook data, and investigation into the factors underlying those data, is needed.

HIBERNATION: ECOLOGY

Denning Ecology of Himalayan Brown Bears in Tundah Wildlife Sanctuary, District Chamba, Himachal Pradesh, India

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There is very little information on denning ecology of Himalayan brown bears (*Ursus arctos isabellinus*). I studied den use and den characteristics of Himalayan brown bears in sun-alpine and alpine areas of Tundah wildlife sanctuary along Pir Panjal range during 2011 and 2012 (May–November). A total of 13 natural rock caves were identified, and all were located

between the elevations of 10200–13800 feet. Brown bear denning in these natural caves were less vulnerable to human disturbance. Bears entered these natural dens as early as 2nd week of November and emerged as late as 1st week of May (Personal observations and by nomadic shepherds). Measurements of dens, entrance aspect, elevation, slope, distance from resting place of herders, and nearby vegetation were also recorded. Two subadult brown bears were sighted and photographed and found sleeping at the entrance of natural rock den at the elevation of 13562 feet. It is the first time that all 13 natural dens were videographed, examined, and monitored in remote and rugged mountainous area. Brown bears presence was confirmed by occurrence of plenty of scats inside all natural dens. Four dens were found to have remains of the rare alpine herb *Selinum vaginatum* (Family Apiaceae; locally called Bhutkesi and known to have aphrodisiac effects), which might have been consumed by bears before undergoing hibernation. My study suggests that Himalayan brown bears were more selective for den site and denned at higher elevation on steep slopes. No excavated dens were recorded. This finding aims that, in a shrinking brown bear habitat in Himalayan region, certain areas still remain critical sites for Himalayan brown bear denning and reproduction, which needs to be further documented and protected for long-term management and conservation of the species.

Aspects of Asiatic Black Bear Winter Ecology in the Indian Himalaya

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In India, Asiatic black bear habitats range from the low hills (>70 m) of northeast India to the subalpine forests near tree line (c. 4,300 m) in the Greater Himalaya. Due to the wide variation in latitude, altitude, distance from sea, and consequently climate conditions, black bears experience varying winter conditions depending upon their locations. This ranges from severe cold conditions (heavy snow and lack of food) in the northwestern Himalaya to milder conditions (no snow and food availability) in northeast hills. Consequently, winter ecology of black bears in the Indian Himalaya is also expected to vary, but information on these aspects is scarce. We investigated aspects of black bear winter ecology in Dachigam landscape in Kashmir from 2007 to 2011 based on sign surveys, telemetry, genetic sampling, and monitoring of human-bear conflicts. The mean hibernation period (days ± SE) of black bear in Dachigam landscape was 63 ± 16 days. Due to climate variability, the extent and intensity of snow fall and snow cover (poor in late autumn/early winter) hibernation was either delayed or reduced. Black bear activity was recorded during late February or early March including long distance movements. There has also been a recent trend of black bear-human conflicts during winter which was not reported in the past. A comparison of bear behaviour and activity in other parts of Himalaya will be presented and discussed along with implications for management.

Black Bear Den Characteristics and Selection in Southeast Alaska

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Knowledge and understanding of black bear habitat use, including den selection, is critical for responsibly managing black bears; however, little is known about den site characteristics in southeast Alaska. We measured and described 52 bear dens used during 2010–2013 on Prince of Wales Island, located in southern southeast Alaska. This island has undergone extensive commercial timber extraction since 1954. Den sites were characterized using a combination of ground-based and GIS-derived measures. We used logistic regression to contrast used den sites with matched random locations. Models showed positive selection of den sites in high-volume old-growth stands and both young (<30 years) and older second growth relative to unforested areas. Only one den occurred in an unforested location, despite 30% of the available landscape being unforested. Models also showed positive selection for steeper slopes. Mean elevation of dens was 234 m (range 27–568). Average elevation for female dens (N = 36) was 204 m (range 59–568) while males (N = 16) tended to den at a higher elevation average of 300 m (range 118–545). Females chose elevated tree cavities more than males did. Males chose

slightly larger diameter breast height trees than females, with or without cubs. All black bear dens were associated with old-growth forest structure, including stumps from harvested trees, live trees, and fallen or standing dead trees. All but one den consisted of an existing natural cavity, although several bears enlarged or modified pre-existing spaces. All bears displayed high fidelity to dens during multiple winters, with no difference between sexes or reproductive status. Four females used several dens during a single winter, a behavior not observed for males. Both sexes showed preference for evergreen boughs (hemlock and cedar) as nesting material but also used *Vaccinium* and *Rosaceae spp.* branches. Den sites observed in this study are almost exclusively associated with large woody structure produced by old-growth timber stands. The recruitment of adequate supplies of these structures for black bear denning should be a consideration in future forest management on Prince of Wales Island.

Characteristics of Natal Dens of Andean Bears (Tremarctos ornatus) in the Tropical Dry Forest of Lambayeque, Peru

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Like all newborn bear cubs, those of Andean bears (*Tremarctos ornatus*) are altricial. Their helplessness and immobility make natal dens critical to their survival. However, natal dens and their selection have been poorly studied among the tropical bears, and only 1 natal den of a wild Andean bear has ever been described. While conducting research in the tropical dry forest of Lambayeque (northwest Peru) from March 2007 through March 2013, we've documented 15 litters of cubs. By using GPS satellite telemetry, direct observation, and searching, we've found the natal dens of 7 litters (46.7%). All these dens were underground, with rock ceilings, and substrates of rock, stones, or soil. All natal dens contained nests of twigs and branches. Based on the measurements of natal dens, it appears that females in this population may use den entrances about 26 cm in diameter (i.e., a female was seen using a den whose largest entrance was 26 cm in diameter). The average number per den of such entrances 1.57 (SD = 0.53, 1–2). More entrances were oriented northward (i.e., NW-N-NE, n = 7) than southward (i.e., SW-S-SE, n = 2), with an average diameter of 72.0 cm (SD = 35.2, 26–152, n = 11). Entrance tunnels were on average 125.57 cm wide (SD = 52.84, 75–230, n = 7), 86.14 cm tall (SD = 27.43, 53–140), and 170.43 cm long (SD = 63.57, 120–265). Natal dens were located on slopes or under boulders, so den chambers were on average 372.86 cm (SD=762.09, 50–2100) below the surface. Within the study site, which includes around 237 km^2 of bear habitat, the average minimum distance among natal dens was 1.01 km (SD = 0.75, 0.13–1.82, n = 7). We found 2 consecutive natal dens for 2 different females; these females used dens 0.13 and 0.78 km away from their previous dens. Liquid water is scarce in this landscape, and we've identified only 7 permanent waterholes. All natal dens were <2 km from one of these waterholes; the average minimum distance between natal dens and a permanent waterhole was 0.88 km (SD = 0.55, 0.23–1.64).
Our ongoing data collection and analyses will shed light on whether females prefer dens and den sites with particular characteristics. Most Andean bears are found in humid montane forests and where those forests are intact, tree cavities may provide alternatives to ground dens. However, these dry forest dens provide a first glimpse at a critical component of the reproductive ecology of this vulnerable species.

HIBERNATION: BEHAVIOR

Winter Months in India Bring Both Sloth Bear Cubs and the Poachers Who Hunt Them

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Sloth bear cubs in India are generally born in the months of November to February, which corresponds with winter months in India. The average sloth bear litter size is 2 cubs. Female sloth bears in the wild may give birth every 2–3 years. Sloth bears select birthing/cubbing dens with extreme care, with preference given to caves that have 2 or more room-like cavities, especially in landscapes with predators like jackals, hyenas, leopards, and wolves who could possibly prey on young bear cubs. The inner-most cavity of the cubbing den selected by the female bear is deep enough with steep sides to prevent the young cubs from climbing out unescorted and exposing themselves to danger. Once the female bear delivers her cubs, she does not emerge from her den for an extended period which can sometimes extend to up to 1–2 weeks. When she eventually does leave her cubbing den to forage and feed herself, she only does so for a few hours at dawn, at night, or the early hours of dawn. Tribal poachers, highly skilled in tracking, can identify female sloth bears and their cubbing dens by reading tracks and signs on the ground. Poachers prefer removing young bear cubs when they are 3–6 weeks old because they are easy to handle, transport, manage, and sell to traders. Poachers wait until the female sloth bear leaves her cubbing den for foraging and then collect a large heap of dry leaf litter in front of the den entrance, which they set on fire which serves as a deterrent in case the mother bear returns to the den while the poachers are still inside the den stealing her cubs. Sloth bear cub poaching has in the past been to mainly supply cubs to the Kalandar community for the dancing bear trade. This demand for cubs in India has for most part been eliminated since the end of 2009. However, poaching of cubs continues along the Indo Nepal border where cubs are supplied for trade in body parts and for the dancing bear practice in Nepal.

Variation in Selective Pressures Influences Expression of Facultative Denning in Ursids

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Organisms have adapted morphological, behavioral, and physiological traits and life history characteristics to maximize fitness in response to perceived selective pressures. Selective pressures can vary spatially and temporally within and among species, particularly in environmentally dissimilar regions. Selective pressures influencing temporal characteristics of denning and hibernation behavior are related to the cost benefit hypothesis of energy conservation, driven by seasonal food availability. Currently, there are 8 extant ursids occupying 4 continents and various ecological niches. Maternal denning, considered obligatory due to the production of highly altricial offspring, has been observed in all 8 species. Facultative denning, which is suspected to be in response to annual environmental cues influencing food availability, has been observed in *Ursus americanus, U. arctos*, and *U. thibetanus*. We reviewed and summarized literature regarding annual and seasonal diet and food availability of ursids. We also characterized environmental factors across species' distributions which have been found to seasonally alter foraging efficiency (e.g., snow cover and sea ice breakup). Species that express facultative denning are primarily herbivorous omnivores inhabiting temperate environments characterized by annual phenological cycles and periods of snow cover across portions of their ranges. Facultative denning has not been reported for *U. maritimus, Ailuropoda melanoleuca, U. ursinus, U. malayanus*, and *Tremarctos ornatus*. We suggest that variation in expression of facultative denning is the result of relaxed selective pressures influencing seasonal food availability due to specialized adaptations to primary food sources (*U. maritimus* and *A. melanoleuca*) and opportunities to exploit primary

foods year round and exhibit prey switching (*U. ursinus*, *U. malayanus*, and *T. ornatus*). Multispecies ecological responses to variation in selective pressures may improve our understanding of the consequences of climate change, potentially altering species' distributions and abundance, phenology of biological events, and severity of seasonal weather.

Den Abandonment by Black Bears (*Ursus americanus*) in Newfoundland

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The use of multiple winter dens by black bears (*Ursus americanus*) has been recorded almost exclusively at southern latitudes in areas without long-term winter snow cover. In 3 study areas in Newfoundland, where median winter snow cover lasts 120–180 days (mid-October to mid-April), we identified den sites remotely using GPS collars that acquired 2–24 fixes/day, and we considered a bear to be denning if it remained in one place >120 hr (5 days). Male and female black bears spent an average of 161 and 185 days denning, respectively, but we documented winter den abandonment in 19 (28%) of 67 bear-winters (18 of 44 radio-collared bears), with some bears using up to 5 dens in a winter. Most dens were abandoned early or late in the denning period, but 5 bears abandoned dens more than a month from either den entrance or emergence. Bears traveled as far as 21 km (median = 945 m, range 36–21,454 m) before denning again, with such moves lasting an average of 87 hr (median = 12 hr, range 1–916 hr). Though we hypothesized that environmental factors or anthropogenic disturbance may have played a role in den abandonment, we did not find a relationship with cover-type, research activities, unseasonably warm weather, distance to roads, year, slope, aspect, or elevation, nor was there a difference in the rate of abandonment between males and females, subadults and adults, or among study areas. We could not assess the effects of microhabitat attributes, relative mass (i.e., condition), or reproductive status (females with or without cubs), but acknowledge that these factors may have played a role in den changes.

The Post-Denning Activities of the American Black Bear (*Ursus americanus*) in Utah

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Understanding the denning behaviors, timing of den emergence, and timing of den departure of female black bears *(Ursus americanus)* in Utah will help biologists establish best management practices. We investigated these behaviors by placing motion-sensing cameras at 34 dens from February to April 2011 and 2012. Each camera was programmed to take 2 pictures with a one second delay between triggers, providing nearly continuous footage of bears at their dens. We documented emergence dates, departure dates, duration of time spent at den, and behaviors outside the den. Mean emergence date for all bears was 15 March (range 28 February–6 April, SD 11 d, $n = 30$). There was no difference in emergence date between the bear cohorts (females with cubs, females with yearlings, and lone females). Mean number of days between emergence and departure for all bears was 17 days (range <0.01 to 47 d, SD 18 d, $n = 19$). Mean departure date was 2 April (range 9 March–8 May, SD 17 d, $n = 19$). When comparing the departure dates of the different cohorts, we found that females with cubs departed their dens later than females with yearlings. Neither females with cubs nor females with yearlings were significantly different from lone females. Mean departure date for females with cubs was 15 April (range 24 March–8 May, SD 15 d, $n = 8$); mean departure date for females with yearlings was 14 March (range 9 March–29 Mar, SD 10 d, $n = 4$); mean departure date for lone females was 1 April (range of 23 March–21 April, SD ± 11 d, $n = 6$).

Associations Between Cub Vocalizations and the In-den Behavior of Black Bear Mothers and Their Cubs: Implications for Acoustic Monitoring of Denning Bears

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The maternal denning period is arguably the most vulnerable stage in ursid life history, and human activities in denning habitat have long been recognized as a potential threat to successful reproduction. However, the protected environment of the den itself has precluded the direct observation of behavioral responses to disturbance, and so our understanding of both proximate and longer-term impacts is lacking. Acoustic monitoring is increasingly being employed to monitor wildlife and has provided valuable insight into the behavior of species that have historically been difficult to observe directly. To explore the application of acoustic monitoring to denning bears, we examined whether cub vocal behavior was a reliable proxy for the activity of both mother and cubs. We analyzed behavioral and vocal data collected from 8 captive black bear litters in maternal dens instrumented with audio-video recorders. For analysis, we combined cub vocals into to 2 mutually exclusive and spectrally distinct categories: CRY (e.g., squawk, cry, whine) and HUM (i.e., "nursing vocalization"). We found that maternal rest was significantly associated with HUM ($P < 0.002$). Conversely, maternal attentiveness towards the cubs was significantly more likely to occur in association with CRY ($P < 0.001$). Cub-active behavior was associated with CRY ($P < 0.01$) and cub-suckle was predictably associated with HUM ($P < 0.001$). From these relationships, managers may be able to infer in-den activities, providing insights into maternal care strategies, possible energetic costs, and the impacts of disturbance on mother-cub relationships. These findings suggest that acoustic monitoring may be a valuable tool for studying the behavior of free-ranging bears in the den.

MANAGEMENT

Source Populations and Roads Influence American Black Bear Recolonization

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Knowledge of species distributions and understanding how populations respond to environmental parameters is important for addressing conservation at a landscape level. We assessed American black bear (*Ursus americanus*) resource selection based on spatial distribution of a recolonizing population in Mississippi, USA. The ideal free-distribution model and risk disturbance hypothesis suggest that black bears recolonizing Mississippi will occupy areas proportionate to resources available while avoiding areas with greater human activity and disturbance. Specifically, we hypothesized bears would occupy areas close to their source population but avoid areas near roads and with greater human population density. Using location data from radio-collared black bears and landscape metrics, we estimated annual population-level space use by using spatial autoregressive modeling. Probability of bear use was greater in areas closer to source breeding populations and areas more distant from roads. Land cover type, elevation, and human population density did not influence black bear occurrence at the spatial resolution examined. Our results confirm that black bears recolonizing Mississippi are occupying

habitats proximate to source populations, supporting ideal free distribution. Further, that bears avoided areas near roads supports the risk disturbance hypothesis. Bear use of areas with greater human population density was likely a consequence of overall low human density and legal protection afforded this species.

The Influence of Habitat Features and Human Land Use on Seasonal Habitat Selection of Asiatic Black Bears

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Although distinct changes in seasonal diet of Asiatic black bears have been well studied in Japan, little has been done to evaluate seasonal changes in habitat selection by Asiatic black bears. Identifying environment factors that most affect seasonal habitat selection is needed for guiding management actions.

We collected satellite relocation data from 16 bears in spring, summer, and autumn of 2009–2012 in the Central Japanese Alps region. Annual home ranges were delineated and used to determine available habitat of each bear. Available habitat was contrasted with seasonal use of habitat units measured from satellite relocation data in order to estimate resource selection functions (RSF) for each bear. Environmental predictors included landcover, terrain, and distance to human features. RSF models for each individual bear were then combined into sex and seasonal specific models (6 unique combinations) to evaluate seasonal and gender-specific responses to environmental factors including the presence of human features.

The effect of human features on habitat selection varied by season and gender, with the greatest impact observed during the summer period when human-bear conflicts were highest. This study provides a basis from which to inform local wildlife managers by ranking habitats based on their selection by bears, while also assessing the effects of human features on seasonal habitat selection of Asiatic black bears.

Assessing a Change in Management Strategy for Black Bears in Capitol State Forest, Washington

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Between 2005 and 2011, we conducted research on black bears in Capitol State Forest (CSF), a 543 km^2 study area in southwest Washington where a spring bear hunt was initiated in addition to the 107-day fall general season. The additional hunt consisted of 100 permits for a 61-day season the first 3 years, followed by 2 years of 50 permits. Our objectives were to estimate survival, density, and home-range size and to detect changes in the bear population as a result of additional harvest. We captured and marked 31 bears 34 times by using 358 trapsets and accumulated 3166 trap nights. The mean annual survival rates from 2006 to 2011 were 0.56 (±0.01) for females and 0.59 (±0.02) for males. Harvest averaged 9 bears/year for the 5 previous years (general fall season only) and increased by 47% to an average of 18 bears/year as a result of the additional spring hunt season. By the 4th year with the additional hunt, hunter days per kill increased from approximately 175 days/kill to over 800 days/kill, indicative of a major decrease in the bear population. Using population reconstruction from known mortality each year, known density of collared bears, and the average growth rate from the literature, we estimated density of bears in CSF at approximately 12–16 bears/100 km^2. When we attempted to determine the rate of decline, we found that at a density of 12, 14, and 16 bears/100 km^2 the CSF population would've been extirpated, declined by 50%, and remained stable, respectively. Since we know the population persisted, but showed significant change, we concluded that the density of 14 bears/100 km^2 was the most realistic. However this exercise highlights how

slight differences in density can have significant impacts on population persistence and estimating rates of harvest. We faced significant challenges trying to estimate bear density while concurrently trying to reduce the population and caution agencies from taking that approach. The need for long term research to assess population metrics and document changes is critical, but adaptive management is more robust when efforts are made to collect and assess baseline data before management changes are implemented.

Habitat Selection of Scandinavian Brown Bears *(Ursus arctos)* for Managed Stands in Autumn and Options for Alberta Forestry

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Brown bear populations in Alberta, Canada, have been recently declining, while populations in Sweden have increased over the past century from historic lows. Both populations occur in managed boreal forest ecosystems, although forest management and history differs substantially between the 2 regions. In Sweden, forestry has a long history with pre-commercial thinning and commercial thinning while silvicultural thinning is absent in Alberta. The effect of forestry on bears is not fully understood, particularly how silvicultural treatments affect habitat quality and habitat selection of bears post-treatment. We used GPS telemetry for 30 bears in Sweden with locations acquired every 30 minutes together with data on forest habitat and management to analyze habitat selection during the late hyperphagia period in autumn (September and October) of 2010. All bears, including the groups of females with cubs and males, selected for commercial thinned mature stands over non-commercial thinned matured stands. Males also selects for stands that has been pre-commercial thinned. In general, when selecting for commercial thinned stands, bears selected for stands that had older commercial thinning treatments, and when selecting for pre-commercial thinned stands, bear selected for stands that had a younger pre-commercial thinning. Forest silviculture positively influences bear's habitat selection during autumn, likely due to increased berry production following thinning which opens the canopy and increase food supply. We suggest that pre-commercial and commercial thinning may be effective wildlife enhancement tool considered in Alberta where populations are limited by food.

Assessment of GPS Location Bias in the Rugged Mountain Terrain of Northwest Montana

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There has been a vast improvement over the past decade in radio-transmitters used to study the movements and habitat use of wildlife. Specifically, with the advent of Global Positioning System (GPS) transmitters, there has been an improvement in the quantity and quality of telemetry locations. In 2004, Montana Fish, Wildlife and Parks started monitoring the grizzly bear (*Ursus arctos*) population vital rates and trend in the Northern Continental Divide Ecosystem (NCDE). By placing radio-collars on bears, we were able to observe their fate and reproductive performance. These locations are often assumed to be unbiased relative to habitat and topographic features, but this assumption is rarely met for a number of reasons. The performance of GPS collars varies with collar construction, brand, programming, environmental factors, and animal behavior. GPS data contains failed or missed location attempts that reduce the overall fix success rate of the collars

to less than 100%. To more accurately develop habitat models, this bias needs to be accounted for. Developing a model to understand and correct for factors that influence fix success rates in the NCDE will better inform researchers and managers of the habitat that grizzly bears may be selecting for that is not represented in its GPS location data.

A Select Panel of Polymorphic Microsatellite Loci for Individual Identification of Asiatic Black Bears (*Ursus thibetanus*) in Dachigam Landscape, Kashmir, India

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To develop molecular genetic tools for individual identification of Asiatic black bear from hair and faecal samples, we carried out genetic sampling using hair snare stations placed in 23 grids (2 × 2 km) of an intensive study area (90 km^2) in Dachigam National Park, Kashmir, during 2008–2010. We screened 20 microsatellite loci with 18 reference individuals. Seventeen loci showed high success rate. Of these seventeen, 13 loci did not show any allele dropout or other associated genotyping errors as reflected by triplicate genotyping. The number of observed alleles ranged from 3 to 9, with overall mean number of alleles per locus of 6.53 (1.89 SD). Observed and expected heterozygosity ranged from 0.188 (MSUT 1) to 0.94 (MSUT 8 & UT35) and from 0.36 (MSUT 1) and 0.84 (MSUT 2 & UT 38), respectively. From the results of screening of 20 loci, we selected 7 highly polymorphic loci (i.e., UT-38, MSUT-2, G10-J, MSUT-8, MSUT-6, UT-25, and MSUT-4) for individual identification of Asiatic black bears from DNP. The cumulative power of discriminating individuals (PID) and siblings (Psib) using the select panel of these 7 microsatellite loci was found to be 2.97×10^{-9} and 7.96×10^{-4}, respectively, suggesting this panel would easily discriminate among individuals in the wild.

A Potential Technique for Modeling Harvest Vulnerability of Urban/Suburban Black Bears in the Mid-Atlantic

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Increased numbers of reported human-bear conflicts have directly influenced management decision for bears in New Jersey, Pennsylvania, and West Virginia for at least the last decade. This pattern is reflected in most jurisdictions that manage black bears (Ursus americanus) east of the Mississippi River. Hunting has been recommended for reducing some types of human-bear conflicts. Hunting may not be available as a tool in urban situations because of safety zone restrictions and reduced hunter access. Relative risk modeling is an analysis tool that allows researchers to determine the risk of an event (e.g., harvest of a bear) relative to exposure to risks. Our objective was to calculate harvest vulnerability of urban black bears in Pennsylvania, West Virginia, and New Jersey. We captured 108 bears across 3 states (77 in PA, 17 in WV, and 15 in NJ) and fitted bears with GPS/GSM collars. We subset locations that were taken during the hunting season. We further split the dataset into bears that were harvested and bears that weren't harvested. We determined the relative risk ratio of harvest for grid cells in each study area. We used a synoptic modeling approach to determine what environmental covariates influence harvest risk. We hypothesized that distance to roads, presence within the safety zone, and sex of the bear would influence the relative risk of harvest for black bears.

Use of Fluoxetine for the Treatment of Compulsive Behavior in Captive Asiatic Black Bears

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Asiatic black bear (*Ursus thibetanus ussuricus*) is one of the animals that has a huge home range, and they display frequently stereotypic behavior in captivity. These behaviors are arguably reminiscent of human obsessive–compulsive behaviors, which respond to selective serotonin re-uptake inhibitors (SSRIs).

This study was conducted for the analysis of treatment effect on Asiatic black bear's compulsive behavior. Four captive bears in Species Restoration Technology Institute of Korea National Park Service were administered fluoxetine during 90 days, and they were monitored through the scan sampling method. Monitoring period was divided into 3 periods (pretreatment: 30 days, treatment: 90 days, posttreatment: 90 days; total 210 days), and blood samples were collected in each period, they were analyzed blood chemistry value. As a result, only one bear completely ceased its compulsive behavior. The others were somewhat decreased in early treatment period. However, after middle of the treatment period, the rate of compulsive behavior was increased again. And there was no meaningful change of blood chemistry value related to fluoxetine administration. So administration of fluoxetine can be considered selectively for the treatment of compulsive behavior in captive Asiatic black bear, but because there is a limit for fundamental treatment, it needs to be used in combination with diverse ecological approaching methods including improvement of captive circumstance.

Washington's Karelian Bear Dog Program: Helping People, Helping Wildlife

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Cooperative Container Modification: A Global Conspiracy to be Smarter than the Average Bear

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I will present with my cooperator Robin Rigg of the Slovak Wildlife Society about the ongoing project to modify trash containers in the Carpathian Mountains using Interagency Grizzly Bear Committee Bear Resistant Container Protocol and report on my recently IBA funded Exchange Grant that was part of this program. Video of testing and modifications will be used.

POLAR BEARS

Variation in the Fatty Acid Composition in Polar Bear (*Ursus maritimus*) Adipose Tissue in the Canadian Arctic

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We determined the fatty acid composition of individual polar bears (*Ursus maritimus*) in 3 Canadian Arctic regions: Baffin Bay, Gulf of Boothia, and Lancaster Sound. We sampled the adipose tissue of 156 harvested polar bears from the subsistence hunting seasons from 2010 to 2012. Lipid was quantitatively extracted from polar bear adipose tissue and fatty acid (FA) data was expressed as the mass percentage of total FA ± 1 SEM. Fatty acid composition in adipose tissue of polar bears varied spatially across the 3 geographic regions. Fatty acid composition distinguished between polar bear subpopulations with 88% accuracy indicating that polar bears can be spatially separated according to their unique fatty acid signature. When examining within each region age class, sex, and season had no significant effect on the fatty acid profile of polar bears. Regional differences in fatty acid composition represent varied foraging patterns across each region as a result of different resource availability and accessibility. The 3 subpopulations support some of the highest densities of polar bears in the world, and the ecological factors supporting these densities are poorly understood. These findings can provide insight on the foraging patterns of polar bears and future shifts associated with changing sea ice conditions. Future work will include quantifying the proportion of prey found in the diet of individual polar bears.

Characterizing the Reproductive Cycle and Pregnancy in Polar Bears *(Ursus maritimus)* through Noninvasive Monitoring of Hormone Metabolites and Ceruloplasmin Activity

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Poor reproductive success and high cub mortality threaten the demographic security and genetic diversity of both ex situ and in situ polar bear populations. The Association of Zoos and Aquarium's Species Survival Plan for polar bears recommends breeding programs to increase the number of animals available for conservation education, research, and to act as a hedge against species extinction. Unfortunately, many attempts at breeding polar bears in captivity have been unsuccessful because little is known regarding their reproductive physiology and birth management. Pregnancy in polar bears is also difficult to determine by hormone monitoring alone due to the phenomenon of pseudopregnancy, where behavioral and hormonal changes of females are similar to true pregnancy. Ceruloplasmin (CP), an acute-phase protein associated with the immune system and inflammation, has been indicated as a biomarker of pregnancy in canids and giant panda. A similar biomarker of pregnancy in polar bears would greatly aid reproductive management of this species but has yet to be examined. Urine and feces were collected from female polar bears in North American zoos to examine whether

fluctuating concentrations of hormone metabolites (progestagens, estrogens, testosterone, and prostaglandin) and CP provide physiologically relevant information useful for the prospective monitoring of polar bear reproductive status. The objectives of this study were to (1) examine urinary hormone metabolites from female polar bears over time, and at distinct periods, in relation to reproductive events (i.e., breeding season, early and late gestation period, and anticipated parturition); (2) compare profiles of urinary hormone metabolite concentrations to fecal hormone metabolite profiles; and (3) examine the utility of CP as a biomarker of pregnancy or a prognosticator of pregnancy loss. Endocrine metabolite concentrations in urine and feces were examined through enzyme immunoassay, and urinary CP by its enzymatic activity. Matched urinary-fecal profiles suggested that urinary estrone-glucuronide was elevated during breeding similar to fecal testosterone. Urinary progestagens (P) also increased after breeding at a similar time and magnitude (~2 fold) as the increase in fecal P. Urinary P of both parturient and non-parturient females was elevated for 50–137 days during late fall. Elevated CP activity during the peri-implantation period for parturient females was likely related to the general inflammatory response associated with endometrial growth and placentation as has been described for canids. Alternatively, elevated CP values during diapause or after implantation in non-parturient females could indicate pregnancy failure. CP activity also correlated with elevations in estrone-glucuronide and prostaglandin during late fall, presumably signaling uterine involution and the end of the reproductive cycle. The noninvasive collection and analysis of urinary hormone metabolites and pregnancy biomarkers can help guide husbandry decisions and allow managers to plan breeding pair introductions, support term pregnancy, and increase neonatal survival. In addition, these data may help establish baseline information for more advanced reproductive technologies such as artificial insemination. A greater knowledge of the reproductive physiology of captive polar bears may also provide information on the occurrence and plasticity of reproductive events in free-ranging animals and potential insight into the causes of reproductive failures in declining populations.

Assessing Polar Bear Stress in Western Hudson Bay: Cortisol as a Biomarker

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The Arctic is warming faster than more southern ecosystems in response to climate change, with the most pronounced effect being the marked seasonal loss of sea ice and diminished period of effective coverage. Sea ice is the primary habitat for the top predator in the Arctic, the polar bear (*Ursus maritimus*), a species that uses the ice as a platform to travel, hunt, and mate. There is an urgent need to develop reliable and insightful biomarkers of health and population stress because of the cost of research on this species, the difficulty in determining the status of individuals and populations, and the decline of their habitat. Physiological responses to stress may have implications for the performance of an entire population. As such, a better understanding of how polar bears are responding to environmental disturbances is an important step toward developing an early warning signal for the population as a whole. The goal of this project is to assess cortisol levels in archived polar bear fur samples as a noninvasive proxy for long-term physiological stress response. Unlike conventional matrices for cortisol analysis, hair includes an average of the blood cortisol concentration throughout the summer growth period, while eliminating the confounding influence of the stressful capture event. Using hair samples collected from 2004 to 2012 in the Western Hudson Bay subpopulation, cortisol levels from subadult (n = 144) and adult (n = 533) bears of both sexes will be analyzed. Currently samples are being processed at the University of Saskatchewan, and results will be analyzed through the summer months of 2013. We hypothesize that cortisol concentration will be influenced by (a) the body condition of the bears at the time of ice breakup (morphometric measurements, body fat), (b) the date of ice breakup, and (c) the sex, reproductive status, and age of the individual. The breadth of our dataset will provide high resolution insight into temporal trends in the stress burden of the Western Hudson Bay subpopulation while repeat sampling of individuals across multiple years will determine the influence of individual variability. By correlating our cortisol data with known biotic and abiotic stressors, we will be able to assess the health of the subpopulation while statistically identifying patterns in the data for further investigation of causal links.

From Supermarkets to Sea Ice: RFID Tags for Grizzly Bear and Polar Bear Management

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Grizzly bears and polar bears are important ecological, cultural, and subsistence components of Arctic terrestrial, nearshore, and marine ecosystems and are likely to interact with offshore and onshore industrial developments. Much of our knowledge about bear populations, habitat use, movements, and interactions with oil and gas activities on Alaska's North Slope has been the result of observations of telemetrically collared bears (VHF and satellite). For polar bears, and to lesser extent grizzly bears, most information comes from females and subadults because, due to their neck anatomy, adult male bears have a low retention rate for collars. Application of existing and emerging Radio Frequency Identification (RFID) technology, commonly used for commerce, could increase the sample of marked bears by decreasing the cost and providing a method to mark males. We tested the feasibility of the RFID system by incorporating an active RFID chipset into an ear tag and modifying the reader and antenna system for use in aircraft and land vehicles. We attached the ear tags on 52 polar bears and 22 grizzly bears in 2006 and 20 polar bears in 2007. We detected signals from tags at distances up to 500 m at ground level and up to 1.7 km from an aircraft flying at approximately 600 m altitude. This exceeded our signal range expectations. However, tag retention, especially for female grizzly bears with dependent young and for adult males, was a major limitation. Due to the unexpectedly long effective range of the tags, it would be useful to pursue other configurations (e.g., subcutaneous implants) that might provide a solution to tag retention. In addition, our omnidirectional receiver system could be modified to allow directional tracking of the tags. Future potential applications of RFID technology for bear research and management include monitoring bears in areas where visible collars are inappropriate or monitoring individual animal presence at specific locations of interest such as carcasses, villages, or industrial sites.

Human–Polar Bear Conflict Reduction and Mitigation in WWF Supported Projects

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As a result of climate change, and the associated loss of sea ice habitat, polar bears are forced to spend longer times ashore as has been observed in certain locations, such as in the Southern Beaufort Sea and the Western Hudson Bay (Towns et al., 2009). The more time polar bears spend on land, the greater the chance for interaction with humans. This increasing chance of conflicts often lead to the death of "problem bears" and death or injuries to humans. Polar bears respond to a variety of attractants such as walrus haul-outs, human food sources, carcasses of butchered whales and seals, dogs, and waste disposal areas. Although currently relatively few conflicts arise compared to the number of polar bears, scientists believe that the number of conflicts is likely to rise in the near future. WWF supports initiatives of local communities, governmental agencies, and other NGOs to prevent and avert conflicts between people and polar bears. The goal of these initiatives is 2-fold: reduced threat of polar bears to people and their property and reduced number of polar bears killed in defense of life and property. These initiatives include sharing best practices of polar bear conflict avoidance with local communities, scientists and commercial sectors (tourism, mineral extraction); improving waste management and storage of human and dog food in key villages; supporting "polar bear patrols"; deploying people who deter polar bears from villages and safeguard local communities; and supporting knowledge exchange trips among local communities.

An Overview of Nunavut's Polar Bears and Their Management

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Nunavut is one of the few places on Earth where a large carnivore like the polar bear *(Ursus maritimus Phipps)* still roams unrestricted within its natural range. Although hunted to near extinction by the early 1960s, the polar bear is a success story of international conservation and management efforts made by the 5 polar bear nations: Russia, Denmark, Canada, USA, and Norway. The Canadian territory of Nunavut plays a major role in this effort because the jurisdiction manages more than half of the world's polar bears. As a species that is harvested for subsistence and cultural purposes, the polar bear plays an important role in Inuit society. The Government of Nunavut works in a comanagement framework that ensures the polar bear harvest in Nunavut is sustainable, but requires that new scientific techniques are being developed and employed in order to monitor subpopulation status. However, these successful management efforts remain largely unknown because of the messaging of "doom and gloom prophets" or the misinformation presented by the media. Environmental change is occurring in the Arctic, yet some of the predictions include uncertainty. This poster gives an overview of Nunavut's polar bears, polar bear management, and harvest monitoring systems, and illustrates how traditional and scientific knowledge is used to ensure the sustainability of polar bear populations for generations to come.

Distribution of Polar Bear Denning Habitat in Canada: A Meta-Analysis of Existing Sources

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The 1973 Agreement on the Conservation of Polar Bears includes a guiding statement that "each Contracting Party shall take appropriate action to protect the ecosystems of which polar bears are a part, with special attention to habitat components such as denning and feeding sites and migration patterns, and shall manage polar bear populations in accordance with sound conservation practices based on the best available scientific data." (Article 2). In the intervening years, each country that contains polar bears (Canada, USA, Norway, Greenland, Russia) has invested, to varying degrees, resources towards the research and protection of habitat components related to polar bear denning. Within Canada, protected areas have been established, because of their importance for polar bear denning, in 2 locations: Wapusk National Park in Manitoba and Polar Bear Provincial Park in Ontario. These 2 areas protect large parts of the denning area for the Western and Southern Hudson Bay polar bear subpopulations. In the remaining Canadian subpopulations, polar bears in denning areas are protected by harvest management regulations. This nonspatial approach to protection is largely due to the ecology of polar bears in areas where denning is more dispersed. However, numerous denning areas have been identified in other regions, by traditional ecological knowledge holders and polar bear researchers. As climate change causes changes in northern ecosystems and allows for increased anthropogenic activity, it is important to learn more about polar bear denning habitat on a national scale.

This project examined the existing literature – including scientific papers, government publications, consultant reports, and traditional ecological knowledge studies – to identify and map polar bear denning areas in the Canadian Arctic. Maps from the literature were georeferenced to record both the study area (map extent) and the dens (points) or denning areas (polygons) within each study area. This provided a visual means to identify areas within Canada that are data poor, in addition to areas that are important denning areas. GIS data were also categorized based on publication year to identify how effort may have changed with time.

We identified sizable areas where no information has been collected regarding polar bear denning. Major gaps in our knowledge occur in the Canadian Arctic Archipelago where ice models predict the last areas of summer ice to occur. Most recent polar bear denning area data has been collected through traditional knowledge surveys, and this points the way towards effective future monitoring. It was also clear that, with the exception of information for Western Hudson Bay, there has been very little published data to address questions of denning habitat characteristics, changing habitat suitability, or shifts in habitat use. We suggest that, throughout Arctic Canada, more effort should be devoted to identifying productive denning areas and monitoring them as conditions change in future years. The value of traditional knowledge studies in identifying polar bear denning areas highlight the importance of including local communities in the monitoring and management process.

ECOLOGY

Ecology of Brown Bears (*Ursus arctos*) within a Coastal Region of Katmai National Park Alaska

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Large carnivores have an essential role in maintaining the health of many ecosystems around the world. Gaining a better understanding of the ecology of brown bears within the coastal regions of Alaska will help us to better know their role in maintaining the health of these ecosystems and better know how to manage and conserve this large carnivore. We conducted our study within the coastal region of Hallo Bay, Katmai National Park, Alaska. This study occurred over a 2-year period during the summer months of June–August of 1998 and 1999. Data on the number of bears present by time and day, cohorts, habitat type being used, and activity were collected from scan counts conducted multiple times a day from towers. We also collected weather data at time of each scan. We found that counts of bears were highest during late June and July and decreased during the month of August. We found that bear counts were lowest during early morning hours and highest during the evening hours. There was no difference between the occurrences of different cohorts throughout the summer. Occurrence of observed bear activities differed by month. The use of different habitat types by brown bears also varied by month. This was likely attributed to availability of resources such as salmon and clams at different times. From this study we have a better understanding of the use of these coastal regions by brown bears throughout the summer and the resources that they use. This information can be valuable in managing these areas so that human activity and other disturbances are reduced in areas that are being used by brown bears at different times of the summer. From this data we can also better predict the ecological role that brown bears have in these coastal ecosystems. Moreover, this information provides evidence of the importance of protecting these coastal regions for the value that they have for brown bears.

Grizzly Bear Foods in the Greater Yellowstone Ecosystem, 1891–2012

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The distribution and abundance of food resources used by grizzly bears (*Ursus arctos*) in the Greater Yellowstone Ecosystem (GYE) have changed over the last 4 decades. Determining the diet breadth of grizzly bears in the GYE is important to document future changes in food resources and the way those changes may affect the nutritional ecology of grizzlies. No single compilation exists of all foods consumed by grizzly bears in the GYE, so we conducted a thorough literature review and compiled an annotated list of species consumed by grizzly bears in the GYE during the 122-year period from 1891 through 2012. GYE grizzly bears consumed 157 plant species, including 4 aquatic plants, 4 ferns, 86 forbs, 31 graminoids, and 25 shrubs, as well as cambium, catkins, and nuts from 7 tree species, including seeds of whitebark pine *(Pinus albicaulis)*, which is an important fall food when available. In addition, 7 species of fungi were consumed, primarily false truffles *(Rhizopogon* spp.*)*. We also documented bears feeding on at least 1 amphibian, 3 bird, 4 fish, and 25 mammal species (Table 1). The primary mammals consumed were bison (*Bison bison*), moose (*Alces alces*), elk (*Cervus elaphus*), mule deer (*Odocoileus hemionus*), pocket gophers (*Thomomys talpoides*), voles (*Microtus* spp.), and ground squirrels (*Spermophilus spp.*). Grizzly bears also consumed at least 36 species of invertebrates, primarily ants (*Componotus* spp., *Formica* spp.), army cutworm moths (*Euxoa auxiliaries*), hornets (*Vespula* spp.), and earthworms (*Lumbricidae*). Consumption of 1 species of algae and 1 soil type were also documented. In total, grizzly bears consumed at least 234 species within 179 genera from 4 kingdoms. Of all foods consumed, 75 species were frequently used by bears and 153 species were used opportunistically. Six species were likely consumed incidentally. Based on our literature review, 2 significant changes in grizzly bear diets in the GYE were evident during 1891–2012. With human settlement of the Yellowstone region in the 1880s, the availability and consumption of garbage increased until the late 1960s when sanitation efforts substantially reduced the amount of garbage consumed by GYE grizzly bears. A second diet change involved consumption of Yellowstone Lake cutthroat trout which, following establishment of YNP in 1872, underwent a long period of decline followed by a period of increase, and then another period of decline. Grizzly bear consumption of cutthroat trout, followed a similar pattern. The diet breadth demonstrated by GYE grizzly bears suggests they can exist in a wide range of environmental conditions. With potential changes in climate, the abundance and distribution of the foods currently consumed by GYE grizzly bears may change. Indeed, a third diet change has been inferred: high mortality of mature, cone-producing whitebark pine trees has been observed over the last decade and its ecological ramifications on grizzly bears are still being investigated. Our annotated list of food items will help managers of grizzly bears and grizzly bear habitat document future changes in grizzly bear food habits and the way those changes may affect the nutritional ecology of GYE grizzly bears.

Impact of Biotic Pressures on Brown Bear Habitat in Kugti Wildlife Sanctuary, Himachal Pradesh, India

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We studied the impact of biotic pressures on habitats of Himalayan brown bear in Kugti wildlife sanctuary, Himachal Pradesh. Information was collected by conducting field surveys, interviewing the villagers and shepherds, and walking on 35 transects during 2007–2010. In 175 plots along transects, evidence of biotic pressures such as cattle grazing (dung), cut/fell and lopped trees, collection of non-timber forest produce (NTFP), distance from human habitation, disturbance from roads, camping of graziers, and other human activities were recorded in the well designed formats. Human population in

the Kugti village was estimated to be 1442 and livestock population was 736 as per the village questionnaire survey. Grazier parties visiting different pastures (n = 12) of the wildlife sanctuary was about 84, and their number of livestock was more than 15000. About 85.38 km^2 of Kugti was found to be highly affected and was less occupied by the bears. About 76.68 km^2 was affected low and 114.57 km^2 was medium in terms of biotic pressures, whereas only 102.37 km^2 of area was without any biotic pressures. Maximum number of cut/fell trees per hectare was observed in mixed forest with conifer and broad-leafed species (57.15), followed by Himalayan moist temperate forest with conifers (44.59); agricultural habitat (11.93); areas near water bodies, river, and streams (5.02); grassland and forest gaps and subalpine forest dominated by birch and fir species (1.57); and moist subalpine scrub characterized by *Rhododendron* species (0.31). Dung abundance per hectare was found to be maximum in grassland and forest gaps (36.74), followed by Himalayan moist temperate forest with conifers (13.50); mixed forest with conifer and broad-leafed species (13.19); areas near water bodies, rivers, and streams (12.56); agricultural habitat (12.25); dry alpine scrub characterized by *Juniperus* species (5.97); exposed rocks with slope grasses (4.71); subalpine forest dominated by birch and fir species (4.40); moist subalpine scrub characterized by *Rhododendron* species (2.83); and glacier and snow-covered peaks (0.31).

We identified 23 non-timber forest produce items, which were collected by the villagers from the bear areas. Though the NTFP items had significance for livelihood of people, dhoop (*Jurinea macrocephala*), koud (*Gentiana kurrooa*), potish (*Aconitum chasmanthum*), and salam panjha (*Dactylorhiza hatageria*) were found to be very important. Indiscriminate collection of NTFP in huge quantity from these areas found to exert tremendous pressure on brown bears and their habitats. The bear areas were found to be highly disturbed during the collection time of NTFPs. Many of the NTFP, such as guchhi (*Morchella esculenta*), ann *(Nepta laevigata)* and aru *(Prunus persica)*, were the main food items of bears, and these were increasingly collected by the villagers. The forest cover, which was already disturbed, degraded, and insufficient to sustain bear needs, was exploited by the people who collected food items important to Himalayan brown bear diets.

Influence of Food Resource on Movement and Habitat Selection of Japanese Black Bear in Summer

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In summer, the Japanese black bear mates and their body condition reaches the bottom. Thus, summer period is an important period for the bear. Because food resource is known to be one of the most important factors influencing the behavior of Ursidae, we studied relationships between summer behavior of Japanese black bears and food resource. In this study, we set up 3 hypotheses. (1) Home range size of Ursidae is inversely related to the amount of food resource. Availability of ants, which is the main food of our study area in summer, decreases over time. Therefore, home-range size of the bears will increase over time. (2) Ursidae are known to select area with abundant food resource. Therefore, the bears will select area with abundant ant resource. (3) In a study of American black bear, their patch residency time was shorter in food-rich area. Therefore the bears will increase movement speed in area with abundant ant resources.

We evaluated ant resource in each vegetation type. We also analyzed temporal change in home-range size, habitat selection, and movement speed in each vegetation type, using GPS location data of 10 adult single females in summer (early June–early August).

Home-range size increased from early June to late June and decrease in early July, and then home-range sizes did not change. Thus, hypothesis 1 was rejected. Mating behavior may have influenced home-range size. Ant resource was relatively higher in open vegetations such as bare land and the bears selected those vegetations as their home range. For home-range selection, hypothesis 2 was correct. The bears increased movement speed in vegetation with abundant ant resource, and therefore hypothesis 3 was correct. Our study suggested that home-range selection and movement speed of Japanese black bear were influenced by food resource in summer.

Food and Feeding Habits of Asiatic Black Bear in Dachigam National Park, Kashmir, India

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We investigated the food and feeding habits of the Asiatic black bear (*Ursus thibetanus*) in Lower Dachigam (ca. 95 km^2) area of Dachigam National Park, Kashmir, India, from June 2007 to October 2011. In total, 13 transects/trails and 120 vegetation plots covering all habitat types of the study area were used to quantify bear food availability and collect bear scats. To assess the availability of fruits, we selected 10–15 individuals of 14 important bear food plants in all habitats of the study area. The phenology of vegetative and reproductive parts of bear food plants was recorded to understand the selection of food type by black bear in different seasons. The nutritional analysis was carried out only for the major food species (>5%) based on the percentage frequency of occurrence in diet. The food production varied seasonally with the hard and soft mast production being highest in summer and autumn. The mean abundance of fruits was significantly different among the seasons (Kruskal–Wallis test: K = 35.3, P <0.0001, alpha= 0.05 at 1000 Monte Carlo simulations). Of the 162 direct feeding observations, black bears were found feeding mostly on fruit bearing (66%) plants, followed by crop lands and orchards (14.3%), and herbs and grasses (10.5%). The micro-histological analysis of 451 scats revealed a significant seasonal variation in bear diet (χ^2= 157.39, df = 12, P < 0.001), and there was no significant variation in black bear diet between years (Levene's test, F = 0.01, df = 3, P =0.99). Thirty-four food plant species were recorded in black bear diet. Food items that formed significant proportion of black bear diet were *Quercus robur, Prunus sp.*, and *Morus sp.*, which had high calorific value. Cultivated crops such as maize, apple, cherry, and pear also contributed to black bear diet because bears raided crops in the villages located in the fringes of the study area. Implication for management of black bear in the area will be presented and discussed.

Sloth Bear Habitat Use and Food Availability in North Gujarat

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We assessed sloth bear habitat use and food availability in the North Gujarat landscape (970 km^2) that included forested habitats of Balaram Ambaji Wildlife Sanctuary, Polo Reserved Forest, and agriculture lands surrounding village areas from Banaskanth to Sabarkantha districts. For assessing Sloth bear habitat use, we used visual encounters and sign (tracks, scats, feeding, and vocalizations) surveys (n = 36, 180 km of effort). For every encounter (n = 766), data on terrain, habitat, and vegetation types were recorded. Seven vegetation types viz., riverine forest, Prosopis-Acacia mixed forest, Ziziphus mixed forest, Prosopis scrub, mixed dry deciduous forest, Diospyros scrub, and Diospyros-Milliusa and Cassia scrub, and others such as open bouldery areas and crop fields were used by sloth bears. Each trail was walked 5 times in 3 different seasons of all 3 years to know habitat use by sloth bear. For the assessment of fruiting plants available in the area, we laid 38 transects covering all forest types, and their flowering and fruiting conditions were recorded. Number of transects varied depending upon habitat type and area. Sloth bear encounter rates (signs/km walk ± SE) were high in riverine forest (4.11 ± 1.58) followed by crop fields (2.56 ± 0.50), bouldery area (2.29 ± 0.17), PABMF = Prosopis-Acacia mixed forest (2.04 ± 0.40), ZMF = Zizyphus mixed forest (1.74 ± 0.15), P. scrub = Prosopis scrub (1.41 ± 0.17), MF = mixed forest (1.33 ± 0.13), D. scrub = Diospyros scrub (1.22 ± 0.11) and DMC scrub = Diospyros-Miliusa and Cassia scrub (1.06 ± 0.11). Many fruits which are important foods to sloth bear were found throughout the year, important species such as *Cassia fistula* and *Ficus spp*. During monsoon, available fruits were *Grewia hirsuta, Ficus racemosa, Ficus virens* and *Aegle marmelos*. Fruits such as *Zizyphus mauritiana, Z. nummularia, Z. oenoplia, Z. xylopyrus, Grewia flavescens, G. hirsuta* and *G. tiliafolia*

were available in winter. During summer *Mangifera indica, Aegle marmelos*, and *Alangium salviifolium* were available. This study is expected to reveal the potentials of the sloth bear use of different terrains in various habitat types. Survival of the sloth bear depends on availability of suitable habitats, food, water, and shelter within these habitats. The results of habitat quantification of sign surveys, food plant availability in different seasons, food plant distribution in different forest types, and management implications will be presented and discussed.

An Attempt to Use a Video Camera Collar to Study the Feeding Ecology of the Japanese Black Bear

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This behavioral analysis study examined the effectiveness of collar cameras on 2 Japanese black bears (*Ursus thibetanus japonicas*). Collars mounted with video cameras were attached to the bears. The interval recording was delayed to start because the anesthesia used on the bears may have some effects on their behavior after release. Each collar also had a GPS to track the bear's movement and a timer controlled device to let the collar fall off for retrieval after the planned recording time was over. One collar camera was attached to a female with 4 hours and 46 minutes of video image taken over a 2-day period in 2010. Another collar camera was attached to a male, and the video image was 5 hours and 59 minutes over a 4-day period in 2011. From these images, the bears' activities were categorized as "walk" for moving with a long stride, "slow walk" for foraging for food or exploring the area, "rest" for being inactive, and "sleep" for sleeping. Under these categories, sub-activities were identified as "sniffing" for getting the nose close to an object for more than one second or moving it up and down, "searching" for looking around, and "feeding." For each of these activities, the time length was measured in units of seconds. With high-resolution video image, the herbaceous species were identified, as well as the parts of the plants (stem, leaf, etc.) eaten. As a result, a quantitative assessment was conducted on the feeding behavior by calculating the frequency and amount of time spent on feeding on each food source. The footage of the male from 2011 showed some courtship activities, such as moving alongside another bear and what seemed to be mounting behavior for mating. Although the current video camera collar is limited with a short recording time, it made it possible for this study to examine the feeding ecology of the Japanese black bears, a species that is difficult to observe directly in its habitat. Camera collar can be an effective research tool for behavioral studies to examine the social and mating behaviors of bears.

Change in Dietary Adaptation of Sloth Bear in Nilagiri Range, Odisha, India

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Sloth bears stray out of the forests at night and invade human settlements around the reserve forest. They smash into pens and coops to kill poultry. Bears also hunt grazing goats near the forest. Fifty-one such cases were reported during 2009–2011. This is an unusual feeding behavior of sloth bear. To learn the feeding habit of sloth bear (*Melursus ursinus*) in highly disturbed habitat, a preliminary study on the food habits was conducted in Swarnachuda Reserve forest of Balasore Wildlife Division, Eastern India. A total of 159 scat samples were collected during November 2011–March 2012. Seven species of food items, i.e., 5 species of animal matter, 2 species of plant, and unidentified matter (hair and bones), were found. Termite was reported to be the major part of the diet, being 33.3% ($n = 53$), followed by Ziziphus species 32.7% ($n = 52$). The feeding habit of sloth bear was found to be largely dependent on the availability of food resources in that area. Therefore, bears and other wildlife rely on human food resources. Increase in the predatory behavior of sloth bear is a sign of increasing human sloth bear conflict (HBC) in the Reserve. To reduce HBC, the following remedies are suggested: communities must reduce cattle grazing and unsustainable exploitation of forest products, and the government must prohibit industrialization in and around Reserve forest areas.

Food and Habitat Use of Andean bear (*Tremarctos ornatus*), in the Cerro Negro, Puerres, Nariao, Colombia

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I studied the food supply and the habitat use of the spectacled bear (*Tremarctos ornatus*) in the forest habitat and paramo in the Cerro Negro, between 3000 and 3500 meters above sea level. We estimated the percentage cover of forest and páramo habitat, finding that 58.19% is contributed by the forest while the 41.81% is being provided by páramo. I found a total of 1222 signs of activity, with plant meals being the highest (841 records), while visits to camaretas or cabins was reported with only 1 record. The paramo habitat presented activity logs more high, being the category Paramo mixed the most used by the Andean bear. The activity and habitat use of the spectacled bear was affected by season, with the largest registers of activity during the summer over winter. The plant species that provide a greater percentage of coverage within the habitat forest correspond to *Clusia multiflora* Rose with a 10.25%, followed by *Orophanax* sp. providing a 8.2% within the treeline. Another finding was that the epiphytic vegetation had an important contribution within the forest. *Guzmania candelabrum* departed from a 8.2%, followed by *Anthurium* sp. with the 5.29% contribution of coverage within the forest. The species with reduced contribution of coverage correspond to *Miconia harlingii* with 0.19% and *Weinmania* sp. with a 1.23% contribution of coverage in the diet. The spectacled bear found in the Cerro Negro consumes 17 plant species, of which 13 were found with evidence of consumption in the field. The species most consumed were *Espeletya pynchophylla* (16.30%), *Gregia* sp. (11.32%), *Guzmania* sp. (10.25%) and *Blechnum* sp. (15.22%). In the scat it was found that the Andean bear consumed 10 of the 17 species found. *E. pycnophylla, Gregia* sp., and *R. floribundus* species showed the greatest contribution to the material in the scat. The species that were not consumed in the field were *R. floribundus* and *H. heterophylla*, whereas the species *Guzmania* sp., *Pernettya prostrate, Miconia* sp., *Gaiadendron punctatum*, and *Agrostis calamagrostis* did not have records of observation in fecal matter.

Myrmecophagy and Radioactive Contamination on Japanese Black Bears in Nikko-Ashio Mountains by the Fukushima Nuclear Power Plant Explosion

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A 9.0-magnitude earthquake struck the northeast area of Honshu Island, Japan, on 11 March 2011. The subsequent tsunami damaged the Fukushima First Nuclear Power Plant, resulting in the meltdown of 3 core reactors and the release of radioactive material into the surrounding environment. Contamination levels were particularly high in the Tohoku and Northern Kanto areas of the island. So far, reports of radioactive contamination of game mammals were posted on websites of several prefectures. These included contaminant levels of 125 Asiatic black bears sampled in 9 prefectures. Levels of 134Cs and 137Cs in these 125 bears ranged from 0 to 1850 Bq/kg. Over half of the reported bear samples would exceed acceptable levels (i.e., 100 Bq/kg) of radiation for food consumption. Unfortunately, our study area of the Nikko-Ashio Mountains in Tochigi and Gunma Prefectures, Northern Kanto area, was not exception from the contamination. Although our study field is apart from the Nuclear Power Plant (=160 km), the contamination level observed in our bears seemed to be higher than contamination in the area of Fukushima prefecture, which is closer to the plant (our study area: 609 Bq/kg ± 203 SE, n = 4 versus Fukushima prefecture: 212 Bq/kg ± 276 SE, n = 76). We have therefore started to monitor the contamination level, 134Cs and 137Cs, both of the bears and of the habitat since autumn 2011 by using a germanium semiconductor detector. We have measured radioactive contamination levels in bear food items (10 species of hard masts: 110 Bq/kg ±72 SE, n = 10; 11 species of soft masts: 81 ± 105 SE Bq/kg, n = 11) and in soil samples under the masting trees (for the hard masts: 974 Bq/kg ± 731 SE, n = 10; for the soft masts: 1181 Bq/kg ± 595 SE, n = 11). Although the migration coefficient (MA) between the masts and the soil was significantly differed between the mast type (soft masts: mean 0.17 ± 0.03 SE, n = 10; hard masts:

0.07 ± 0.02 SE, n = 11) (U-test, P = 0.029), the MA values were not remarkably high. Hence, the high level of radioactive contamination in bears in our study area was not simply explained through mast-feeding behavior by the bears. However, we found that there were significant differences of contamination level on bear scats between those which contained mast matter (291 Bq/kg ± 62, n = 12) and those which contained social insect matter (i.e., ants; 3143 Bq/kg ± 863, n = 3)(U-test, P = 0.0044). In our study area, ants are a variable food resource during summer when mast is sparse, and therefore the bears have fed heavily on them. Myrmecophagy level of the bears was estimated from 7 to 10 hr/day (Yamazaki et al. 2013). Assuming the bears spend such a vast time feeding for the ants at the ground level, they may have opportunity to take in a considerable amount of highly contaminated soil with the ants. This phenomenon is the same as in wild bores, who basically feed at ground level, and a high level of radioactive contamination has been reported in the Tohoku and Northern Kanto areas. This study was partly supported by a grant from the Wildlife Research Center of Kyoto University.

The Gobi Bear: A New Subspecies of Brown Bear (*Ursus arctos gobiensis* or *U. a. isabellinus*) from the Gobi Desert of Mongolia?

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We conducted a survey of mitochondrial DNA (mtDNA) of the Gobi bear to provide a more definitive picture of its place in Asian brown bear taxonomy. While these bears are almost certainly members of *Ursus arctos*, their subspecific status is questionable. This assessment could prove crucial in determining future steps needed for recovery of this population of only 22–31 bears that persists in the southwestern portion of Mongolia abutting the Chinese border. A previous study analyzed only 4 loci on 8 samples, with mtDNA connection that was inconclusive (Waits et al. 2009 and Masuda et al, 1999), and concluded that Gobi bears were *Ursus arctos isabellinus*, the same subspecies that occurs in northwestern India, Pakistan, and perhaps other countries north of Pakistan along the western border of China. The bears are isolated from other Ursus populations by ~1200–1400 km in western or northern Mongolia or China. Our assessment compared mtDNA and nuclear (nDNA) to test hypotheses that Gobi bears are a separate subspecies of brown bear and have undergone a bottleneck due to their isolation. We compared samples from Gobi bears with samples of Mongolian brown bears from the northern provinces of Khentii, Selenge, and Khovsgol and the far western province of Bayan-Ulgii using 2 mtDNA primers. We also used brown bear sequences from North America, Europe, Tibet, Russia, and Hokkaido from Genbank for additional comparisons. The genetic differences between Gobi bears and brown bear populations in North Mongolia, West Mongolia, North America, and Europe showed a high Fst value (0.67–0.97). The genetic distance between Gobi bears and the other brown bear populations was 1.6%–2.1% based on mtDNA COXII gene (664 bp). Moreover, mtDNA D-loop sequence data also showed very high genetic distance (7.2%–10.4%) due to a rapid rate of evolution. That Gobi bears formed a cluster separately at the phylogenetic trees indicates that those bears are ancient. Thus, the Gobi bear seems likely to be genetically different from other brown bear subspecies in North Mongolia, West Mongolia, Europe, and North America according to mtDNA 2 markers. Further research of mtDNA and nDNA markers with additional specimens from Himalayan brown bears *(Ursus arctos isabellinus)* are needed to further clarify the taxonomic status of Gobi bears.

PHYSIOLOGY/PARASITES/DISEASE

Noninvasive Monitoring of Fecal Glucocorticoid Metabolites in Spectacled Bears (*Tremarctos ornatus*)

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Objective: Monitoring fecal glucocorticoid metabolites (fGM) is a noninvasive method to measure stress in wild animals and zoo animals. Even if there is a great demand to assess stress in spectacled bears, there are so far no methods validated for this species. To achieve a reliable method the laboratory process had to be analyzed, and a challenging test had to be set up as available for other species (Touma and Palme 2005, Wasser et al. 2000).

Material and Methods: Feces of 5 male and 8 female bears (3–32 years old) housed in 5 German zoos were collected weekly and stored at –20 °C until processing. The samples were extracted and analyzed. Afterwards recovery, parallelism and inter- and intra-assay coefficients were determined. In a 12-day stress provocation test fecal samples were collected daily. An artificial stressful event was set up at day 6 to evince that stress causes increased fecal glucocorticoid metabolite levels.

Results: Parameters for validation of the laboratory process evidenced that our radioimmunoassay gives reproducible and reliable values for the fGM-content of the analyzed fecal samples. The minimum detection limit of the assay is 0.176 ng/g feces. Serial dilutions revealed dilution coefficients of 57.88% ± 4.32% and the determined recovery is 93%. Inter- and intra-assay coefficients were around 12%. The stress-provocation test evinced 2- to 3-fold increased fGM concentrations after the intervention to prove that these procedures can be used to detect stressful situations.

Conclusion: Using noninvasive methods to identify stress in spectacled bears gives great opportunity to improve knowledge about their physiology and pathology under human care as well as free-ranging. Possible fields of application can be investigations about habitat changes or the Spectacled Bear Alopecia Syndrome.

Touma, C., and R. Palme. 2005. Measuring Fecal Glucocorticoid Metabolites in Mammals and Birds: The Importance of Validation; Annals of the New York Academy of Science 1046:54–74.

Wasser SK, Hunt KE, Brown JL, Cooper K, Crockett CM, Bechert U, Millspaugh JJ, Larson S, Monfort SL. 2000. A Generalized Fecal Glucocorticoid Assay for Use in a Diverse Array of Nondomestic Mammalian and Avian Species; General and Comparative Endocrinology 120, 260–275.

Echocardiographic and Pulse Wave Doppler Findings in Indian Sloth Bear (*Melursus ursinus*)

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Indian sloth bear (*Melursus ursinus*) aged 4 years from wildlife SOS, Bangalore was presented to the Veterinary College Hospital, Hebbal, Bengaluru, India with the clinical signs of anorexia and respiratory distress over a period of one month. The bear was on xylazine and Ketamine anaesthesia. Echocardiography was performed on right lateral parasternal position over the palpable cardiac impulse, at the fourth to sixth intercostal spaces and between the sternum and costo-chondral

junctions. All the echocardiographic measurements were carried out on right parasternal window with the animal lying in lateral recumbency. The transducer was placed through a hole underneath the specially designed echocardiographic table. Two-dimensional measurements for Aorta (Ao) and Left Atrium (LA) were obtained from a short-axis plane at the level of the aortic valves and LA, Ao and LA/Ao ratio was 4.01 cm, 3.05 cm and 1.31, respectively. Simpson's rule was used to calculate left ventricular volume from a right parasternal long axis four chamber view. End Diastolic Volume (43.70 ml), End Systolic Volume (11.67 ml), LV diastolic length (5.12 cm) and LV systolic length (4.04 cm) were recorded. In the present case, index of sphericity (1.43) was reduced, which indicated left ventricular dilatation and ejection fraction was 73.3%. Left ventricular M-mode measurements were taken from right parasternal short axis view at the level of chordae tendinae. Left ventricular internal dimension in diastole (3.57 cm), Left ventricular internal dimension in systole (3.32 cm), Left ventricular free wall in diastole (1.39 cm), Left ventricular free wall in systole (1.03 cm), Interventricular septum in diastole (1.03 cm), interventricular septum in systole (0.97), right ventricular internal dimension in systole (2.36 cm), right ventricular internal dimension in diastole (1.93 cm) and fractional shortening (6.78%) was recorded. Right ventricle was dilated and there was mild mitral valve thickening. For mitral valve M-mode, right parasternal short axis view was used. Transducer was angled more dorsally to record the "fish-mouth" view of the mitral valve. In M-mode, the excursions of the anterior and posterior leaflets with time were recorded. E point to septal separation in the present case was 0.85 cm. Pulse wave Doppler aortic outflow and pulmonic outflow was obtained from the right parasternal 5-chamber view, and its measurements were recorded.

Diets Higher in Polyunsaturated Fatty Acids May Yield Health Advantage for Bears – Preliminary Findings

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Grizzly bears have an amazing propensity to store massive amounts of fat each fall to serve as their main source of energy throughout the winter. Thus, bears have evolved mechanisms to cope with fat accumulation and extreme metabolic shifts without any deleterious effects to their health or heart function. We are investigating the effects of the type of dietary fat on cardiovascular function and other heath parameters of grizzly bears prior to hibernation. We hypothesized that bears eating a diet high in polyunsaturated fatty acids (PUFA) would manifest healthier cardiovascular parameters.

Four trained grizzly bears are being used to determine the effects of dietary fat on cardiovascular functions. The bears were divided into 2 groups. Group 1 was fed a diet high in PUFA (salmon, salmon oil) while Group 2 was fed a diet high in saturated fats (beef and dairy products). Both diets were provided in addition to a common base of commercial dog chow and apples. Complete dietary analyses were performed on all foods fed. Percent body fat composition was estimated by deuterated water dilution with the goal of maintaining similar body fat measures between bears. Plasma fatty acids (FA), blood pressure (BP), and numerous cardiac parameters were measured in the active summer season (before diets) and prior to hibernation.

Fall plasma FA analysis differentiated the 2 groups, particularly in the omega 3 PUFAs which ranged from 5.6 to 17.6 times higher in Group 1. Similar to humans, bears on the saturated fat diet manifest diastolic hypertension in the fall with BP measures that were 25 mmHg higher on average. Sluggish cardiac motion was also noted in Group 2 with slower systolic contraction and diastolic relaxation velocities.

Preliminary findings suggest that grizzly bears manifest healthier cardiovascular parameters eating a diet high in PUFA. These findings may have implications for captive bears and bears close to human food sources.

Nutritional Wisdom of Bears: Macronutrient Selection and Metabolism

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Many animals consume mixed diets that maximize their fitness by optimizing macronutrient intake. We tested whether grizzly bears (*Ursus arctos horribilis*), a generalist omnivore that hibernates, *(i)* regulated their diet to a common nutrient target, *(ii)* achieved a nutrient target related to fitness, and *(iii)* selected a nutrient target that differed between seasons and from other species with differing life histories. When given unlimited access to 2 or 3 highly digestible foods, one of which always contained primarily protein (lean salmon or beef) and others that contained primarily lipid (salmon oil or beef and pork fat) or digestible carbohydrates (bread or apples), grizzly bears selected diets in which protein provided 17% ± 4% of the metabolizable energy and 22% ± 6% of the dry matter. This dietary protein content maximized the rate of gain per unit of energy consumed, is similar to the level preferred by other omnivores but is less than that preferred by carnivores. Bears strongly preferred lipids over carbohydrates, but they used lipids and carbohydrates with equal efficiency to dilute dietary protein content to a level that maximized mass gain per unit of energy intake. Thus, dietary sources of lipids and carbohydrates play an extraordinarily important role in determining the productivity of bears that goes beyond simply their role in providing energy.

Apparent Digestibility and Food Passage Time of Asiatic Black Bears (*Ursus thibetanus*)

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Asiatic black bears (*Ursus thibetanus*) are one of the largest carnivores, but they are omnivorous, especially drawn to vegetation food. The objective of this study was to determine the digestion and utilization of different types of foods by Asiatic black bears. Four captive bears (2 males and 2 females) at the Low Altitude Experiment Station of the Endemic Species Research Institute of Taiwan were the study subjects and were fed 8 foods. With a specific food, each feeding trial lasted 12 days, but food intake and defecation was monitored by collecting and weighing all feeding and fecal residues for only the last 3 days. Cr_2O_2 was added into the food to track the passage and retention time of ingested food. The apparent digestibility of various nutrition components was determined by nutrition analysis of test food, including dry matter, crude fat, crude protein, crude fiber, ash, nitrogen-free extractives, and gross energy. The daily defecation rate of bears averaged 5–6 scats, and the weight of fecal residues varied by foods, i.e., 904–2984 g and 217–391 g for wet and dry scats, respectively. The average passage, retention, and total mean retention time were 6.4 ± 3.7 hr, 34.4 ± 9.5 hr, and 22.0 ± 3.1 hr. The passage time was negatively correlated to crude fiber content, but it was likely influenced by other factors, such as particle size and feeding behavior. For the vegetation and animal foods tested, the apparent digestibility of 4 nutrient components were significantly different ($P < 0.001$). Bears had a higher apparent digestibility for animal foods than for vegetation foods: 83.2% and 62.6% for dry matter, 94.2% and 62.2% for crude protein, 94.1% and 61.8% for crude fat, 93.8% and 64.4% for gross energy. The apparent digestibility of crude protein and nitrogen-free extractives were correlated to their nutrition content correspondingly ($r^2 = 0.70, 0.55$; $P < 0.001$). However, the apparent digestibility of all nutrition components was negatively correlated to the content of crude fiber.

Can Bears be Fatty? Preliminary Study of Adipokines in Brown Bears

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Adipose tissue is an important endocrine organ. It is dynamic tissue with the potential to produce a broad spectrum of biological modifiers. Adipokines are key regulators of energy metabolism, cardiovascular health, and immune function, and their production and function may be influenced by nutrition and reproductive status, with some species-specific considerations. Dysregulation of adipokines appears to contribute to the development of a number of complications associated with obesity. These connections have mostly been explored in humans and rodent models. Similar mechanistic studies are in early stages in dogs, cats, and horses, while there are no known studies in brown bears or other wild animals. Adiponectin has anti-inflammatory and anti-atherogenic properties. Resistin appears to control feeding as well as activating de novo hepatic lipogenesis and peripheral lipid metabolism. Therefore, higher resistin levels may be a marker of systemic inflammation. Myostatin functions as a potent inhibitor of skeletal muscle growth. Moreover, myostatin regulates metabolism and its inhibition can significantly attenuate the progression of obesity and diabetes. In this preliminary study we measured serum levels of adiponectin, resistin, and myostatin in sera of 18 wild and captive brown bears from Croatia. Serum was separated from blood cells by centrifugation and stored at –20 °C until analysis. Assay of serum adiponectin, resistin and myostatin was determined using canine ELISA kits obtained from Biotang Inc., Source International, Camarillo, California, USA, following the manufacturer instructions. The optical density was measured with a microplate reader at 450 nm (Biorad). The standard curve, prepared from 5 standard dilutions in duplicate was used for calculating the concentration of analyte in the samples, expressed in ng/mL. Mean value of adiponectin concentration measured in 15 sera samples was 142.16 ng/mL ± 4.33 (1 SE) with a range from 119.30 ng/mL to 172.40 ng/mL. Median value was 145 ng/mL, ten percentiles was at 122.47 ng/mL and ninety percentiles at 162.79 ng/mL. Resistin in sera was present in mean concentration of 26.64 ng/mL ± 1.61 (1 SE, n = 15) with a range from 11.90 ng/mL to 38.65 ng/mL. Median value was 27.3 ng/mL, ten percentiles was at 21.44 ng/mL while ninety percentiles was at 32 ng/mL. Mean value of myostatin concentration was 903.93 ± 20.95 ng/mL (1 SE, n = 15) with a range from 795.35 ng/mL to 1098.45 ng/mL. Median value was 898.1 ng/mL, ten percentiles was at 805.63 ng/mL while ninety percentiles was at 991.6 ng/ml. Since no previous studies on adipokines in brown bears were conducted the listed means and ranges (10–90 percentiles) represent reference values of the adiponectin, resistin, and myostatin concentration in the serum of brown bears in Croatia. Future research objective is to investigate if in obese bears comparing to "normal" bears different values in adipokines serum concentration are present. The bears from our initial sample could not be clearly separated in those 2 groups and we were not able to point out the differences in obtained serum values. If difference will not be significant the protective mechanisms maintaining adipokines level should be put under the lens.

Helminths of Brown Bears and Asiatic Black Bears of the Russian Far East

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Helminthologic investigations were held within 4 regions of Russian Far East: Primorskii Krai, Khabarovskii Krai, Kamchatkskii Krai and Sakhalinskaya Oblast. From 2010–2011, we collected 84 fecal samples from brown and Asiatic black bears (*Ursus arctos*, *U. thibetanus*) in Primorskii Krai for helminthologic analysis of feces. Bear feces were not distinguished to species, so we joined analysis results of 2 species. From 2010–2011, we collected 408 fecal samples from brown bears in Sakhalinskaya Oblast. Feces were placed in plastic bags and frozen, or preserved in Formaldehyde saline. Fecal samples were subjected to the floatation method, using a saturated solution of ammonium nitrate. Collection of cestodies' fragments from

bear's feces was held in Kamchatkskii Krai (2002–2004, 2 samples) and in Sakhalin (2010–2012, 9 samples). Cadavers of 12 brown bears (8 from Kamchatkskii Krai, 2 from Sakhalinskaya Oblast, 1 from Primorskii Krai and 1 from Khabarovskii Krai) and 2 Asiatic black bears from Primorskii Krai were studied using the method of full helminthological necropsy. Helminths, which were discovered by necropsies and retrieved from feces, were examined using helminthoscopy. Data about trichinosis of brown bear was given by Ministry of Agriculture of Kamchatkskii Krai, Veterinary Science Agency of Kamchatkskii Krai, and Sakhalin Interregional Veterinary Laboratory. We used molecular-genetic method to distinguish to species cestodies' strobila fragments from Kamchatkskii Krai and Sakhalinskaya Oblast and to identify species of Trichinella from Primorskii Krai. Using method of helminthologic analysis of feces, 5 species of helminthes of brown and Asiatic black bears were found in Primorskii Krai: nematode *Baylisascaris transfuga, Thominx aerophillus, Aonchoteca putorii, Strongylata* suborder and trematode *Dicrocoelium lanceatum*. Helminthosis agents were discovered in 41.7 % of feces samples. The necropsies of brown and Asiatic black bears found 2 more species of nematode in Primorskii Krai: *Trichinella nativa* and *Dirofilaria ursi. D. ursi* was also found in brown bear from Khabarovskii Krai. Helminthofauna of brown bears in Sakhalinskaya Oblast (according to helminthologic analysis of feces, distinguishing to species cestodes from bear's feces, and 2 necropsies) is represented by at least 4 species: *nematode Baylisascaris transfuga, Strongylata* sp., *Dirofilaria ursi* and *cestodes Diphyllobothrium nihonkaiense*. Helminthosis agents were found in 27.5 % of feces samples. We discovered 14 species of helminths of brown bear in Kamchatkskii Krai which are represented by 9 species of nematode (*Thominx aerophilus, Trichinella nativa, Soboliphyme baturini, Crenosoma vulpis, Baylisascaris transfuga, Pseudoterranova decipiens, Anisakis simplex, Histerothylacium sp., Dirofilaria ursi*), 3 species of cestodes (*Diphyllobothrium nihonkaiense, Spirometra erinacei-europaei, Mesocestoides kirbyi*) and 2 species of acanthocephalans (*Corynosoma strumosum, C. enhydry*). From 2003–2010 extent of Trichinella infestation was 30.6 % (n = 471) in Kamchatkskii Krai. Extent of Trichinella infestation is much lower in Sakhalinskaya Oblast, in 2006–2011 this rate was 2.4 % (n = 254). Trichinosis is hazardous to man's health. It is registered yearly in the Russian Far East, and commonly people get infected with it after eating bear meat.

Understanding Baseline and Elevated Urinary Cortisol in a Captive Polar Bear

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Glucocorticoids are a critical component of the stress response in animals, including the hormone cortisol in bears. Cortisol levels can be used as an index of stress when studying how bears respond to changes in the environment and when making management decisions regarding captive animals. However, cortisol varies in circadian and circannual rhythms and is integral to many physiological processes. For example, cortisol can stimulate or reduce feeding behavior and can enhance lipolysis through direct and indirect pathways. Reduced feeding and mobilization of stored fat are normal aspects of hibernation for many bear species. Thus, it is important to understand normal fluctuations in cortisol before relating cortisol levels to stress.

We measured the ratio of cortisol to creatinine in urine samples collected from a female polar bear (aged 16 years at study initiation) over 22 consecutive months at the San Diego Zoo. This approach quantifies free cortisol (assumed to be more biologically active than bound cortisol) and corrects for fluctuating urine concentration. The bear was in a public exhibit (0.8 ha) for the majority of the study with a male bear and his sister (both aged 11 years), but the bear was housed alone during the fall pregnancy watch. Throughout the study period we made daily observations of behavior and food consumption. In the first 12 months of sampling, high cortisol in winter (February–March) was generally associated with increased social interactions and breeding activity. Cortisol was low in spring, summer, and autumn; activity level and appetite were low throughout late summer and autumn, and body condition increased. A spike of high cortisol in late October was not associated with social or husbandry changes. In the subsequent 10 months of sampling, cortisol was high between February and May, spiking in April. In February, the female's interactions and sexual behavior with the male began intensifying, peaking in late April and early May, when daily copulation was observed. Cortisol also spiked in July, August, and November. While there were no social or husbandry changes associated with these spikes, activity and appetite were low, and body condition increased. Preliminary analyses indicate that time of day does not strongly influence urinary cortisol. Pending analyses will increase sample sizes for testing for an effect of time of day, identifying seasonal peaks, and identifying potential correlations with social and husbandry changes.

Session 12
POLAR BEARS II

Polar Bears from Space: Assessing Satellite Imagery as a Tool to Monitor *Ursus maritimus*

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Development of noninvasive, cost-effective techniques for monitoring polar bears is a priority, given the rapidly changing Arctic environment and growing concerns related to traditional capture-recapture techniques. Remote sensing affords researchers access to difficult-to-reach sites without associated safety concerns and disturbance to wildlife. We evaluated the utility of high resolution (sub-meter) satellite imagery for monitoring polar bears in northern Foxe Basin, Nunavut, Canada. Foxe Basin provides an ideal setting for assessing remote sensing methods for polar bears: recent comprehensive aerial surveys of this subpopulation have documented very high densities of polar bears on some relatively small islands (totaling <3000 km^2) with little topographic relief and no snow cover during the late summer, ice-free season. We conducted a helicopter-based aerial survey and procured matching satellite imagery from selected islands in the study site. We sighted 56 clusters totaling 77 bears along 400 km of aerial transects. Results from directed ground-truthing indicated that polar bears can be reliably identified and distinguished from similarly-sized objects with high resolution panchromatic satellite imagery in low topography areas. We used data procured from the helicopter-based survey and satellite imagery to generate independent estimates of polar bear abundance via distance sampling and manual counts, respectively. Satellite imagery was reviewed by multiple observers and data analyzed in a mark-recapture framework to estimate detection probabilities and examine potential sources of heterogeneity, such as background color, off-nadir angle, and satellite platform. High-resolution imagery shows promise as a tool for monitoring polar bear populations and distribution in high-density areas during the ice-free season. Consistency in detection, comparability of the abundance estimates, overall quality of the imagery, and relative costs will be among the factors used to more thoroughly evaluate applications of satellite imagery in other regions and at broader geographic scales. Future research should focus on assessing imagery for polar bears in high topography sites, on-ice habitats, and regions with lower bear densities.

Assessment of Vehicle and Pedestrian Noise Transmission into Artificial Polar Bear Dens at Milne Point, Alaska

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Oil and gas activities on Alaska's North Slope overlap spatially with polar bear maternal denning habitat and temporally with the sensitive peri-partum and emergence periods. Noise associated with these activities can be substantial, and concern regarding the impact on polar bears has long been acknowledged. However, the difficulties of measuring behavioral responses to noise disturbance due to logistical constraints (i.e., subnivean denning and regulatory protections) prompt the need to develop models of disturbance that include an understanding of both the acoustic ecology of the species and received noise levels in the den. Here we characterize the transmission of vehicular and pedestrian noise into artificial polar bear dens. We excavated 4-single chambered dens in naturally drifting snow. Two dens were left with an opening to mimic den configuration during the emergence period. Each den was equipped with a ½" condenser microphone and preamplifier

connected to a digital acoustic recorder. We ran three 6 km transects for each of 9 vehicles operating at standard operating speed and/or altitude. We also performed pedestrian transects within 150 m of the dens. Vehicles recorded included a Bell-212 helicopter, Twin Otter fixed wing aircraft, snow-machine, Tucker tracked vehicle, and various types and sizes of on-road truck. We present broadband sound level profiles for the length of each transect as well as unweighted and polar bear weighted 1/3 octave band plots at the closest point of approach (CPA). We also compare data from closed and emergence dens. For example, unweighted SPL at CPA was on average 22.5 db re 20 µPa higher in open dens than in closed dens for aircraft, and 14 dB higher for tracked tundra vehicles. These data, coupled with audiometric data, will enhance estimates of both noise exposure for polar bears in maternal dens and aid in the development of appropriate mitigation strategies.

A Circumpolar Monitoring Framework for Polar Bears

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Polar bears (*Ursus maritimus*) occupy remote regions that are characterized by harsh weather and have limited access. Polar bear populations can only persist where temporal and spatial availability of sea ice provides adequate access to their marine mammal prey. Observed declines in sea ice availability will continue to do so as long as greenhouse gas concentrations rise. At the same time, human intrusions and pollution levels in the Arctic are expected to increase. A circumpolar understanding of the cumulative impacts of current and future stressors is lacking, long-term trends are known from only a few subpopulations, and there is no globally coordinated effort to monitor effects of stressors. Here we describe a framework for an integrated circumpolar monitoring plan to detect ongoing patterns, predict future trends, and identify the most vulnerable polar bear subpopulations. We recommend strategies for monitoring subpopulation abundance and trend, reproduction, survival, ecosystem change, human-caused mortality, human-bear conflict, prey availability, health, stature, distribution, behavioral change, and the effects that monitoring itself may have on polar bears. We assign monitoring intensity for each subpopulation through adaptive assessment of the quality of existing baseline data and research accessibility. A global perspective is achieved by recommending high intensity monitoring for at least one subpopulation in each of 4 major polar bear ecoregions. Collection of data on harvest, where it occurs, and remote sensing of habitat, should occur with the same intensity for all subpopulations. We outline how local traditional knowledge may most effectively be combined with the best scientific methods to provide comparable and complementary lines of evidence. We also outline how previously collected intensive monitoring data may be sub-sampled to guide future sampling frequencies and develop indirect estimates or indices of subpopulation status. Adoption of this framework will inform management and policy responses to changing worldwide polar bear status and trends.

Effects of Changes in Sea Ice in Hudson Bay on Body Condition of Southern Hudson Bay Polar Bears

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Polar bears are dependent on sea ice to provide access to seals, their main prey. In several subpopulations, declines in sea ice duration due to climate warming have been linked to individual-level effects such as declines in body condition and stature, and to population-level effects such as reduced survival rates and declines in abundance. In the Hudson Bay ecosystem, polar bears have less time to hunt seals than bears in other subpopulations because the ice melts completely in early summer each year. Declines in body condition and survival rates were previously demonstrated for the Southern Hudson Bay subpopulation using data from 1984–1986 and 2003–2005; however, there was no clear effect of changes in sea ice covariates such as break-up date or duration of ice cover. Using a more extensive data set (1984–1986 and 2000–2009) we explore relationships between body condition and various sea ice covariates and consider finer-scale information on sea ice concentrations than previously used to assess these relationships. Body condition of all age and sex classes of bears declined significantly over time; Julian date of freeze-up increased over time as did duration of time on land. The best model to explain variation in body condition contained 2 covariates: Julian date of freeze-up at 20% ice concentration in year prior to capture plus duration of time on land in year prior to capture from break-up at 20% sea ice concentration to freeze-up at 20% ice concentration ($r^2 = 0.5852$, $P = 0.019$). These results suggest there is an additive effect of returning to the sea ice later each fall following an extended period on land combined with a shorter period of ice cover during which to replenish energy stores that results in declines in body condition.

Session 13
ECOLOGY I

Testing the Niche Variation Hypothesis with a Measure of Body Condition

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Individual variation and fitness are cornerstones of evolution by natural selection. Understanding evolutionary and ecological processes requires knowledge of the mechanisms that generate and maintain genotypic and phenotypic variation within populations. The niche variation hypothesis (NVH) posits that when the constraint of interspecific competition is relaxed, intraspecific competition should drive niche expansion by selection favoring the use of novel resources. However, niche expansion at the population-level could be achieved in two ways: (1) by all individuals using the full set of available resources, or (2) by each individual using a unique subset of available resources, thereby increasing among-individual variation in dietary niche. Although individual variation can lead to species-level evolutionary and ecological change, observed variation does not ensure the outcome is beneficial. To offer support for NVH, individual fitness should be similar across the range of food resource consumed. Our goal was to test the NVH by examining the relationship between dietary niche and percentage body fat in sympatric American black bears *(Ursus americanus)* and brown bears *(U. arctos)*. Our objectives were: (1) to estimate the relative contribution of terrestrial vegetation, terrestrial meat, and salmon to the assimilated diet of black bears and brown bears, (2) to determine whether resource partitioning is greater within or between species, and (3) to determine whether percentage body fat is independent of dietary niche. As fat deposition in bears is critical for meeting the costs of hibernation and reproduction and has been used previously to infer fitness, bears were weighed in the field and bioelectric impedance analysis was used to estimate percentage body fat. Keratin samples were incrementally removed from the claw on the third digit of the front paw of each individual for stable isotope analysis. We

used a Bayesian-based mixing model to estimate the summer (i.e., July–September) assimilated diet of individual bears by comparing ursid C and N stable isotope signatures with generalized signatures representing terrestrial vegetation, terrestrial meat, and salmon in the same region. We found significant differences in dietary niche among individuals within both species and greater food resource partitioning between species than within species. In addition, percentage body fat was independent of dietary niche for part of the dietary range observed.

Temporal Niche Switching by Grizzly Bears but not American Black Bears in Yellowstone National Park

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Grizzly bears *(Ursus arctos)* have been reported as either nocturnal or diurnal in various studies, but have not been known to switch between the 2 times unless disturbed by humans. Black bears *(Ursus americanus)* are almost solely diurnal in studies unless human influences occur. As human disturbance is often difficult to control, the relative temporal niche of both species remains ill-defined. Thus, the present study examined bears in Yellowstone National Park where hunting does not occur, human activities are relatively benign, and bear species are sympatric to determine if niche occupancy was a stable feature of the species. Onset of activity was anticipatory of both sunrise or morning civil twilight (illumination sufficient for human vision) for individuals of either species. The peak hour of activity in black bears was consistently midday, but fluctuated in grizzly bears from midday during early spring, late summer, and fall to evening during late spring and early summer. Black bears did not temporally avoid the times when the more dominant grizzly bears were active. Mean activity levels were higher for male black bears then both male and female grizzly bears. Together, results suggest that the foraging needs of black bears that are smaller, more herbivorous, and socially subordinate to the larger, more carnivorous, and aggressive grizzly bears necessitate ingestion of less digestible, lower quality foods requiring longer foraging time during daytime hours whereas grizzly bears are more adaptable to dietary needs necessitating greater temporal flexibility.

Body and Diet Composition of Sympatric Black and Grizzly Bears in the Greater Yellowstone Ecosystem

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The grizzly bear (*Ursus arctos*), a threatened species in the Greater Yellowstone Ecosystem, was delisted by the U. S. Fish and Wildlife Service in 2007, but relisted by a court decision in 2010. The court's rational for relisting centered on inadequate documentation regarding the ability of grizzly bears to adapt to the loss of one of its major foods, whitebark pine (*Pinus albicaulis*) seeds. Here we address the court's concern by focusing on body composition and diet of grizzly bears using bioelectrical impedance and stable isotopes to determine if the bears are able to adapt to the potential loss of whitebark pine as an important food resource. We contrast body fat and mass in grizzly bears with a potential competitor, the American black bear (*Ursus americanus*), that should be favored if the quality and quantity of food resources have declined. Our findings suggest that grizzly bears were in better body condition than black bears. We also found no difference in autumn fat levels in grizzly bears in years of good or poor pine seed production and stable isotope analyses revealed this was

primarily a function of switching to meat resources during poor years. Our findings further indicate this dietary plasticity was consistent over the course of our study: we did not detect a downward trend in either body mass or the fraction of the assimilated diet that is composed of meat in grizzly bears over the past decade. However, when analyzed separately, we did detect a downward trend in body fat in adult female grizzly bears after 2006. This decline may be due to the population reaching the ecological carrying capacity of the Yellowstone ecosystem and a natural process of balancing the grizzly bear population with its food resources.

Trends in Causes and Distribution, and Effects of Whitebark Pine Production on Grizzly Bear Mortality in the Greater Yellowstone Ecosystem

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Documented grizzly bear *(Ursus arctos)* mortalities have been increasing in recent years in the Greater Yellowstone Ecosystem (GYE), likely because of increases in bear numbers and range expansion. Previous research has also documented that annual variation in seed production of whitebark pines (WBP; *Pinus albicaulis*), an important fall food, is inversely related to grizzly bear fall mortality. However, WBP trees have experienced widespread mortality during the last decade primarily because of mountain pine beetle *(Dendroctonus ponderosae)* infestations. Therefore, we investigated trends in causes and distribution of mortalities of independent-aged (≥2 years old) grizzly bears in the GYE. Additionally, we used an information-theoretic approach to identify potentially additive factors, beyond population growth and expansion, contributing to human-caused fall mortalities. During 1975–1982 primary mortality sources were poaching, malicious killings, and losses related to conflicts with livestock. At that time, 91% of documented mortalities occurred within the designated Grizzly Bear Recovery Zone. During the 2 most recent decades, the primary source of mortality inside the recovery zone was associated with ungulate hunting, usually involving self-defense kills during chance encounters or conflicts at hunter-killed ungulate carcasses. Also, an increasing percentage of mortalities occurred outside the recovery zone (32% in 1993–2002, 46% in 2003–2012). Mortalities outside the recovery zone were almost equally split among losses related to ungulate hunting, management removals from livestock conflicts, and anthropogenic site conflicts. Of annual documented mortalities for females and males, 85% and 61%, respectively, occurred during late summer and fall (i.e., August or later). Given these trends, we focused our subsequent analyses on human-related fall mortalities during 1983–2012. We used negative binomial regression with mortality count as the dependent variable and accounted for varying mortality exposure due to population size by using annual population estimates as an offset. We used Akaike's Information Criterion (AICc) to evaluate a suite of models representing hypotheses regarding mortality patterns. Our base model included covariates for number of mortalities inside and outside the recovery zone. We examined combinations of WBP indices and covariates for spring carcass abundance and summer growing conditions. We found unambiguous support for a model that included indices of annual WBP production and cumulative mortality of WBP trees (from permanent transects monitored since 2002); an interaction of both WBP indices was not supported. Our findings confirm the number of human-related fall mortalities is associated with annual variation in WBP seed crops but also indicate there is an additive effect associated with cumulative mortality of WBP trees. We interpret the lack of support for the interaction between the 2 WBP indices as an indication that annual variation in fall mortalities due to variable WBP production has not changed despite WBP decline; in other words, years of good WBP production still result in lower grizzly bear mortality during fall.

Session 14
POPULATION ECOLOGY AND GENETICS I

Grizzly Bear Dispersal in Northwestern Montana, USA

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We used 24-loci genotypes from 667 grizzly bears *(Ursus arctos)* genetically captured between 2004 and 2010 in northwestern Montana to create a family tree to characterize dispersal. Our pedigree analysis in program Parente yielded 228 mother-father-offspring triads with parentage probabilities >99%. We used the center of the mother's locations to represent the beginning of dispersal events, and the center of the offspring's locations to represent the end location of dispersal. We used a hierarchical model to assess all three components of natal dispersal: emigration, travel, and immigration. Through the use of covariates, for each sex, we tested three hypotheses: (1) High population density, unfavorable sex-ratios, and high relatedness increase distance emigrated. (2) Barriers (e.g., high-traffic highways, large lakes) and high densities of male bears create higher resistance to dispersing bears than riparian areas, roadless areas, and meadow-shrub vegetation types. (3) Dispersing bears select new home ranges with favorable sex-ratios, low densities, and abundant high-quality habitat. We will discuss features of the family tree we created, the assumptions inherent in the model we used, the factors important to natal dispersal, and implications for connectivity plans and conservation of grizzly bears.

Black Bear Density in Glacier National Park, Montana

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We report the first abundance and density estimates for American black bears (*Ursus americanus*) in Glacier National Park, Montana, USA. The black bear population is sympatric with a grizzly bear population in Glacier National Park. We used data from 2 independent and concurrent noninvasive genetic sampling (NGS) methods, hair traps and bear rubs, to generate individual black bear encounter histories for use in closed population mark-recapture models. We improved the precision of our abundance estimate by using NGS detection events to develop individual-level covariates of sampling effort within the full and ½ mean maximum distance moved (MMDM) from each bear's estimated activity center to explain capture probability heterogeneity and inform our estimate of the effective sampling area. Models including the ½ MMDM covariate received overwhelming Akaike's Information Criterion support suggesting that buffering our study area by this distance would be more appropriate than no buffer or the full MMDM buffer for estimating the effectively sampled area and thereby density. Our model-averaged super-population abundance estimate was 603 (95% CI: 522–684) black bears for GNP. Our black bear density estimate (11.4 bears per 100 km^2, 95% CI: 9.9–13.0) was consistent with published estimates for populations that are sympatric with grizzly bears *(U. arctos)* and without access to spawning salmonids.

Population Demographics of Black Bears in Coastal Louisiana

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The Louisiana black bear (*Ursus americanus luteolus*) was reduced to 3 isolated subpopulations as bottomland hardwood habitat was converted to agriculture in the mid-20th century. These bears were listed as threatened by the U.S. Fish and Wildlife Service in 1992. Recovery requires population estimates to evaluate current status and viability. We conducted a mark-recapture study on one of those subpopulations from 2010 to 2012 in St. Mary and Iberia parishes, Louisiana. Using non-invasive barbed-wire hair snares, we collected 3,698 hair samples during 3 summers and genotyped 1,415 of them. Using a Robust Design Huggins full closed captures with heterogeneity model, model averaged estimates of abundance for females were 86 (95% CI 64–107) in 2010, 71 (95% CI 59–83) in 2011, and 91 (95%CI 72–111) in 2012. Estimates of abundance for males were 59 (95% CI 45–74) in 2010, 55 (95% CI 47–64) in 2011, and 77 (95% CI 62–92) in 2012. Model averaged mean annual abundance was 146.55 (95% CI 116–177). Population growth rate was estimated as 1.10. Apparent survival was higher for females (0.89, SE = 0.06) than for males (0.86, SE = 0.07). Supported models included capture heterogeneity within the population, no temporary emigration, and no behavioral response to capture. We used a Factorial Correspondence Analysis in Program GENETIX to identify genetic clusters within the population and used Program STRUCTURE to assign individuals to clusters based on inferred ancestry. Genetic assignment of individuals was used to estimate that highest probability was for 2 clusters within the population. Finally we mapped clusters using ArcGIS to identify migrants and compare sex-specific movement rates between habitat fragments. Mapping revealed genetic clusters divided by a 2-lane highway adjacent to a cypress/tupelo swamp.

Grizzly Bear Population Augmentation in the Cabinet Mountains of Northwest Montana

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The Cabinet Mountains grizzly bear population 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 conducted during 1990–1994 when 4 subadult female grizzly bears were transplanted to the area. Two criteria were identified as measures of success: (1) bears must remain in the target area for one year and (2) females 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 indicated that one of the transplanted bears remained in the Cabinet Mountains and had reproduced. The detected bear was transplanted in 1993 as a 2-year-old and was identified by a hair snag within 5 miles of the original release site. This and subsequent genetic analysis indicated she is the source of at least 9 F1 offspring and at least 13 F2 offspring. This reproduction indicates that the original test of augmentation was successful with at least one of the transplanted individuals. Success of the augmentation test prompted continuation of this effort. The Northern Continental Divide Ecosystem of north central Montana has been the source of 10 additional bears transplanted to the Cabinet Mountains during 2005–2012. Seven of these individuals were females and 3 were males. One of these females is also known to have reproduced. Three bears were known to have died and 4 bears left the area out of 14 total transplants 1990–2012. Fates and movements of these bears are discussed. The lack of native bears identified since 1989 suggests that the population may have been well below the level of 15 individuals suggested in 1988. Augmentation bears or their offspring have accounted for 34 of 42 genotyped bears since 1989. Three of the 8 unrelated bears are known to be dead. The augmentation effort appears to be the primary reason that grizzly bears remain in the Cabinet Mountains.

TBA

Geographical Population Structure of the Expanding Asiatic Black Bear Population in Japan

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The distribution structure of Asiatic black bears (*Ursus thibetanus*) was estimated using harvest data on the westernmost population in Japan during the period from 2001 to 2011. The area of bear habitat in this region was 5000 km^2 in 1999 and had expanded to 7700 km^2 by 2010, which has led to increased conflict with humans. This study had 2 aims. The first was to identify the core habitat of bears and determine where most females produce offspring. The second was to clarify which sex/age class was most dispersive and contributed to distribution expansion. This information is useful for clarifying the biological traits of dispersion by bears and to facilitate policy on how to best manage conflicts between humans and the

bears at the periphery of the distribution. Core areas were defined as areas of female concentration, in which 90% of the bears were females. Concentric zones, 5 km in width, were drawn both inward and outward from the edges of the core areas, and the sex/age compositions of each concentric zone were compiled and compared.

The relative density of female bears declined more rapidly from the center of a core area compared to that of males. Males and immature females dominated in peripheral areas, which indicates that males and immature females were more prone to disperse from core areas than mature females. This observed dispersive trait of immature females contradicts the widely held view of the importance of philopatry among female bears. One possible cause of this dispersion by immature females is that the core areas have reached their carrying capacity for bears, and thus competition for food resources drives immature females to be more dispersive than usual. This suggestion should be examined further.

Density Dependence, Whitebark Pine Decline, and Vital Rates of Grizzly Bears in the Greater Yellowstone Ecosystem

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Recent evidence suggests annual population growth of the grizzly bear (*Ursus arctos*) population in the Greater Yellowstone Ecosystem has weakened from 4%–7% during 1983–2001 to 0%–2.2% during 2002–2011. The greatest changes we observed were a decrease in annual survival of cubs (1983–2001: S = 0.640; 2002–20011: S = 0.553) and yearlings (1983–2001: S = 0.817; 2002–2011: S = 0.539). Substantial changes in availability of a key food source and bear population density have occurred over the past 10–15 years. Whitebark pine *(Pinus albicaulis)*, a variable but important fall food source for grizzly bears, has experienced substantial mortality due to mountain pine beetle (*Dendroctonus ponderosae*) outbreaks that may be mediated by climate change. Concurrent with changes in food resources, the grizzly bear population has reached high densities in some areas and has continued to expand, now occupying approximately 50,000 km^2. We investigated potential causes of the demographic changes and tested research hypotheses associated with resource- versus density-mediated effects. We focused our assessment on known-fate analyses of cub and yearling survival and developed spatially explicit, individual covariates to measure decline of whitebark pine and change in density. We developed a density index by taking advantage of the consistent and extensive capture efforts in the ecosystem for >3 decades. We backcasted and forecasted lifetime range estimates of known individuals through time and estimated the annual number of grizzly bears within 196-km^2 grid cells for the entire ecosystem, essentially representing spatially explicit population reconstruction. To develop an individual covariate for whitebark pine decline, we used remote sensing to annually map where transitions from healthy to impacted stands occurred. We then overlaid activity centers of grizzly bears with those data to assign an index of density and whitebark pine decline to each individual. We used known-fate analysis in Program MARK and an information-theoretic framework to examine support for alternative hypotheses. We hypothesized that decline in cub and yearling survival because of resource effects would be greater among bears in areas where more mortality of whitebark pine occurred. Alternatively, if density-dependent effects influenced survival, we predicted that cub and yearling survival would decrease as relative density increased. We discuss potential implications of these analyses using projections of annual population growth under different cub and yearling survival scenarios.

Session 15
ECOLOGY II

Influence of Whitebark Pine Decline on Habitat Use of Grizzly Bears in the Greater Yellowstone Ecosystem

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Seeds of whitebark pine (WBP; *Pinus albicaulis*) are a major food item for grizzly bears (*Ursus arctos*) in the greater Yellowstone ecosystem and can represent a significant component of the annual energy budget. Crops of WBP are quite variable, and higher rates of grizzly bear mortality and conflicts have been linked with years of low WBP productivity. Since the early 2000s, infestations of mountain pine beetle (*Dendroctonus ponderosae*) have caused considerable mortality among mature, cone-bearing trees in the northern Rocky Mountains. There is concern this decline may cause bears to reduce their use of this resource and increase use of areas near human activities, possibly resulting in greater conflicts and mortality rates. We used 52,332 GPS locations of 72 individuals (89 bear-years) monitored throughout the peak WBP foraging season (15 Aug–30 Sep) to examine temporal changes in habitat use and movements during 2000–2011. We calculated a Manley-Chesson (MC) index for selectivity of mapped WBP habitats for each individual within its 100% local convex hull home range, and determined the total days and median date that each bear was located within WBP habitat. Twenty-four percent of fall home ranges did not encompass any mapped WBP habitat. Among the remaining 68 home ranges, 65% of bears had a MC index above 0.5, indicating selection for WBP habitats. Linear regression and Akaike Information Criterion model selection indicated mean MC index of individual bears decreased when annual WBP seed production was low over the 2000–2011 period, suggesting selection decreased as availability of the resource declined. Number of days that bears were found in WBP habitat also decreased over time. Median date of use was approximately 6 days later comparing the first to the last year of the 2000–2011 period. Using data from 39 bears (47 bear-years) with home ranges outside of national parks, where human-caused mortality is greatest, we calculated MC indices for use of areas within 500 m of roads. Seventy-five percent of MC indices were below 0.5, indicating avoidance of areas near roads. However, we observed an increase in this index over the study period. In addition, indices for road use and WBP use were negatively correlated among individuals, suggesting bears were more likely to use areas near roads as WBP availability declined.

Black Bear (*Ursus americanus*) Dispersal in Expanding Populations

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Dispersal influences gene flow, population size, and population dynamics, making it essential to understanding the ecology of a species. Both brown bears *(Ursus arctos)* and American black bears *(Ursus americanus)* exhibit female philopatry and male dispersal. However, recent studies have found deviations from this pattern including reduced male dispersal, and/or low or no spatial structuring of relatedness in female-female pairs, with deviations from the expected pattern potentially due to density, mate competition, and resource availability. Expanding populations may also diverge from the more typical pattern of high relatedness of females in close proximity because females disperse long distances. Some American black bear populations have expanded their ranges over the past 3 decades in response to decreased persecution, forest regrowth, and direct species protection. In this study, expanding populations in the Interior Highlands and Cumberland Plateau regions and their respective source populations were explored. For the Interior Highlands, we included samples from the expanding populations in the Missouri and Oklahoma and the potential source populations from 2 locations in Arkansas; the samples from the Cumberland Plateau included 2 localities in Kentucky and the potential source populations included those from Virginia, West Virginia, and the Smoky Mountains in Tennessee. Bears from Arkansas, Oklahoma, and Missouri were genotyped at 15 microsatellite loci, while those from Virginia, Kentucky, West Virginia and Tennessee were genotyped at 20 loci. Relatedness (r) for all pairs was determined using MLRelate. We then determined how relatedness varied in space for each locality for female-female, female-male, male-male, and all dyads. To do this, we performed correlation and regression analyses on the natural log of distance and relatedness, with p-values adjusted for both analyses using Mantel tests, for all dyad types in all locations. Again for all dyad types at each locality, we computed the mean and 95% confidence interval of relatedness for the following distance categories: 1, 3, 6, 9, 15, 30, and 45 km. ANOVA was used to determine if there was a significant difference in relatedness at these distance categories among sites and between source and expanding populations. We expected source populations to more closely follow the pattern of female philopatry and male dispersal but that the expanding populations would potentially show lower levels of relatedness among females in close proximity and that male-male pairs would have higher levels of relatedness than source populations. Average relatedness of female-female dyads declined significantly up through about 30 km between pairs. All pairs and female-male dyads displayed a similar pattern, though with a less-pronounced decline. Males in source populations did not differ in relatedness across space. However, in some expanding populations, this was not the case. With these deviations from more traditional expectations of dispersal patterns, exploration of such variation in expanding populations may have important management implications, particularly because some American black bear populations have expanded in recent years.

Grizzly Bear Use of Wellsites in the Boreal Forests of Western Alberta

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Oil and gas activities are widespread within the landscape of west central Alberta. Landscape disturbances and human-caused grizzly bear mortalities are thought to be significant threats to the Alberta grizzly bear population, yet little is known about the potential impacts of oil and gas wellsites on grizzly bear habitat use. To investigate how bears respond to oil and gas wellsites, we studied grizzly bear habitat selection patterns in proximity to wellsites in the Kakwa area of west central Alberta. We calculated selection ratios at 3 spatial scales: (1) the wellpad; (2) a 500m buffer zone surrounding the wellpad, and (3) the remaining home range. We used logistic regression to examine factors that could influence wellsite selection, including wellsite age (years since construction), wellsite activity status (operational versus abandoned), crown closure, and age-sex class of bears. Both females and males showed selection for wellsites. Wellsite age, crown closure, and bear reproductive status influenced bear wellsite selection. Females with cubs were more likely select for wellsites and also selected for less canopy closure than males and females without young. The activity status of the wellsite did not have a significant effect on wellsite selection. The abundance of bear foods observed growing on many wellsites in the Kakwa region is a probable mechanism for grizzly bear selection of wellpads. Bears attracted to anthropogenic features are at a higher risk of human-caused mortality; therefore, grizzly bear use of wellsites could have negative results for this threatened population. Results from this study increase our understanding of how bears respond to oil and gas developments, with potential implications for management of grizzly bear habitat.

Staying Cool in a Managed Landscape: The Influence of Ambient Temperatures on Grizzly Bear Habitat Selection

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To fulfill their needs for survival, growth and maintenance, thermoregulation, and reproduction, grizzly bears are constantly managing trade-offs between cover and foraging opportunities. The heterogeneous distribution of resources over space and time influences trade-offs in habitat use and leads to the use of different habitat components throughout daily and seasonal periods. Although there is growing evidence of the relationships between ambient temperature and habitat selection in large mammals, the role of environmental conditions and thermoregulation on habitat selection of grizzly bears is poorly understood. In a changing climate, understanding how grizzly bears behave in relation to current and changing weather conditions is increasingly important. Our objective was to investigate the influence of ambient temperature on habitat selection patterns of grizzly bears in a managed landscape. We investigated summer habitat selection for 11 male and 12 female grizzly bears in the Rocky Mountain foothills of Alberta, Canada. Grizzly bear habitat selection followed a daily and seasonal pattern that was influenced by ambient temperature. Young cut-blocks aged 0 to 20 years old provide an abundance of forage but are on average 6 °C warmer than mature conifer stands and 21- to 40-year-old cut-blocks. As maximum daily temperatures increased, the relative change (odds ratio) in the probability of selection for young cut-blocks decreased during the hottest part of the day (midday), and increased during the evening, twilight, and nighttime periods. Concurrently, the odd ratio in the probability of selection for older cut-blocks increased on warmer days. The odds of selecting young cut-blocks also increased from early to later summer while the odds of selecting older cut-blocks decreased. Our results demonstrate that ambient temperatures, and therefore thermal requirements, play an important role in selection pattern and behaviour of grizzly bears.

The Mountain Pine Beetle Epidemic: Estimating the Response by Grizzly Bears to Natural Disturbance Based Harvesting

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In central British Columbia, Canada, the mountain pine beetle *(Dendroctonus ponderosae)* epidemic has killed extensive areas of pine forests and led to increased harvesting in the Prince George Timber Supply Area in an attempt to generate value from those dead trees. In 2010 the Forest Results Based Code for B.C. was revised to recommend basing harvest regimes on historical natural disturbance cycles following an ecosystem management approach. Historically wildfires were predominately >1,000 hectares (ha) with most >10,000 ha, whereas cutblocks were typically <60 ha. We utilized GPS and VHF data on 28 (16 female, 12 male) grizzly bears (*Ursus arctos* L.), 1998–2003, to determine how bears would respond to the implementation of a natural-disturbance-based harvesting pattern. We first determined if grizzly bears selected or avoided forested pine stands in comparison to other forested and harvested landcover types at the population level (second order scale). Grizzly bears significantly avoided forested pine stands even though pine stands were the predominant landcover type, whereas they highly selected for harvested blocks (i.e., cut stands ≤20 years post-logging). We used resource selection modeling to estimate selection coefficients within cutblocks (fourth order scale) in relation to 6 covariates: cutblock size, age, edge distance, greenness, elevation, and the risk of human-caused mortality. The selection for cutblocks varied by season; grizzly bears were more likely to be located in cutblocks in spring followed by summer whereas they avoided using cutblocks in fall. The size of the cutblock was an important influence on selection by bears during the spring and summer but not in fall. Bears were on average 12 times more likely to select for very large cutblocks (66–70 km^2) over smaller blocks but only 3% of blocks were very large. In spring the best predictors of grizzly bear use of cutblocks were higher greenness values and larger block sizes. In summer, bears selected for larger cutblocks with higher greenness values, at higher elevations, and where the risk of human-caused mortality was greater. In fall, bears tended to remain closer to block edges and in younger regenerating stands. Bears spent a significantly greater fraction of their time in cutblocks during the night (52%+/-) than during the day (40%+/-) and during 'active' versus 'resting' periods in all 3 seasons. Selection for large blocks suggests that bears may respond positively to a harvest regime that mimics the size of natural disturbances. However, to determine the net benefit of large cutblocks to bear populations, one needs to compare the foraging benefits to the potential for large cutblocks to contribute to higher grizzly bear mortality.

Joint Estimation of Black Bear Resource Selection and Population Density

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The traditional approach for understanding resource selection and population abundance/density requires separate models for each endeavor. However, it is possible to combine data from the 2 types of studies and estimate parameters of interest into a single modeling effort since both are based on the same underlying process of space-usage. We applied a recently developed joint model that integrates both telemetry data (RSF data) and spatial capture-recapture (SCR) data to estimate resource selection and population parameters. We applied the joint model to a study of a black bear population in a c. 2624 km^2 study area in southwestern New York. SCR data were collected using hair snares during 10-week sampling seasons in the summers of 2011 and 2012; thinned telemetry data from 3 individuals (2 males, 1 female) in the same study area were used for the RSF part of the model. Our model of space usage (i.e., resource selection) within home ranges of bears (i.e., third-order selection) included landscape covariates related to landcover type and elevation. The joint RSF-SCR

model allowed us to simultaneously model movement, resource selection covariates, and population density, resulting in an enhanced and comprehensive understanding of important parameters and patterns of space usage for this black bear population. We discuss the relationships between our modeled covariates describing space usage and our estimate of density, and the implications of how the landscape influenced movement and space usage of individuals within their home ranges.

Andean Bear (*Tremarctos ornatus*) Body Condition and the Effect of Seasonal Availability of Sapote Fruit (*Colicodendron scabridum,* Capparaceae) in the Tropical Dry Forest of Lambayeque, Peru

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Knowledge of the natural history of Andean bears is scarce, especially from the tropical dry forest of northwestern Peru. Evidence suggests that the most important food resource for these bears is the sapote fruit (*Colicodendron scabridum*), available from approximately December to April (summer).

In several groups of mammals, individual body condition influences various demographic parameters, including reproductive rate. Our goal was to assess seasonal variation in body condition of individual Andean bears in the tropical dry forest in relation to the sapote fruiting period. We used >700 camera-trap detections of 19 individuals from 2008 to date, from cameras located at 12 waterholes. These images allowed us to assess body condition through external features (e.g., bone prominence). We used a visual approximation of a previously published body condition index (Noyce et al. 2002) to assess each individual, where the index ranges from 5 (skeletal) to 20 (obese).

The monthly mean body condition index differed between the two months prior to the sapote fruiting season (October–November) and the last 2 months of the sapote fruiting season (March–April). Prior to sapote fruiting the averages for males (8.99 ± 1.65), females without cubs (8.33 ± 1.85), and females with cubs (7.83 ± 1.79) were lower than for those same classes during the last 2 months of the sapote season (12.00 ± 4.06 for males, 10.76 ± 2.85 for females without cubs, and 9.00 ± 2.00 for females with cubs).

There is a positive correlation between body condition and the first month of the sapote fruiting season (December) in males ($R^2 = 0.511$), and the second to last month of the sapote fruiting season (March) for females without cubs ($R^2 = 0.678$), suggesting that there is a time delay in visible change in body condition for females without cubs. There is not a correlation ($R^2 = 0.442$) between body index of females with cubs and the fruiting season. Thus, it appears that sapote fruit located in the lowland areas yield enough nutrients to improve the overall condition of bears that are not lactating, however we have also noted from our telemetry data that females with cubs appear to avoid descending to the lowlands to feed on sapote. Once the sapote fruiting season has finished, bears have limited foraging options, and because these foods are of lower dietary value, bear body condition decreases. During the time bears foraged on sapote, the condition of females with cubs did not increase as much as the condition of males or females without cubs. Thus, females with cubs appear to be the most nutritionally vulnerable individuals in the population, probably due to the higher energy demands of cub-rearing and avoidance to sapote foraging areas which are frequently visited by other conspecifics.

Although sapote is considered Critically Endangered by Peru, human land colonization is reducing its distribution. Because the availability of sapote fruit may affect bear survival and reproductive success in the tropical dry forest, it is necessary to legally protect more areas of sapote near cliffs where the bears den and find refuge.

Session 16
POPULATION ECOLOGY AND GENETICS II

Pedigree Analysis to Assess and Monitor Functional Connectivity of Grizzly Bears in the Transborder Region of Northern Montana, Washington, and Southern British Columbia

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Fragmentation challenges grizzly bear populations in the trans-border region spanning the USA–Canada border in southern British Columbia and northern Montana, Idaho, and Washington. Climate change exacerbates this fragmentation and both issues necessitate management designed to provide options for bears and other wildlife species to move between these ecosystems and mountain ranges to meet current conservation challenges and adapt to ecosystem changes. In 2004, the Trans-border Grizzly Bear Project initiated efforts to understand patterns of fragmentation, identify connectivity options, and implement connectivity management across the trans-border region. We now need to develop methods to monitor the effectiveness of management used to enhance connectivity. Here we describe methods using pedigree analysis to monitor movements, breeding, and geneflow between 3 fragmented and threatened subpopulations and a larger healthier subpopulation in southern Canada. From previous research we have accumulated a thorough genetic sampling of grizzly bears in the region and determined that 21 loci provides sufficient power to detect parent-offspring relationships unambiguously. Our 305 genetically sampled bears represent a high proportion of the subpopulations under study. We genotyped these bears to 21 microsatellite loci and carried out a pedigree analysis (spatial representation of family trees) to document incidents of inter-area connectivity. We identified 110 family units where the allele sharing pattern was perfectly matched to a triad of a father, mother, and offspring. These family units were mapped to determine breeding events that identified 8 family units containing 13 triads that spanned highway and settlement fractures separating these ecosystems. These events revealed 2 mechanisms of connectivity and geneflow. First, a few males were breeding in 2 ecosystems across fractures. Second, we documented natal dispersal events from one ecosystem into another. Consistent with previous research results, we found no evidence of female connectivity between ecosystems. To monitor future connectivity and to assess, inform, and adapt a connectivity management strategy being applied across the region, we plan to continue monitoring these subpopulations with genetic sampling and subsequent pedigree analysis to document potential future inter-area movements that might also be associated with breeding.

Effects of Hunting and Infanticide on Population Growth in Scandinavian Brown Bear

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Although behavior is thought to affect population processes, very few studies have quantified the effect of behavioral traits on population growth. Recent studies suggest that sexually selected infanticide is the main cause of mortality in cubs of the year of Scandinavian brown bear. Thus, this behavior has a considerable effect on individual fitness. However, it is unknown if it also affects population growth. This question is of considerable interest for management, because a relationship between the hunting of adult males and infanticide has been suggested previously and hunting pressure in Scandinavia has increased

greatly in the last decade. We aimed to evaluate the direct effect of hunting and the potential indirect effect of hunting via infanticide on population growth. We used the longitudinal data (22 years) of 180 radio-marked females in south-central Sweden to model these population dynamics. We calculated the demographic rates and the asymptotic growth rate of the population in periods of low and high hunting pressure. To assess the importance of cub survival on population growth, we conducted prospective and retrospective demographic analyses. The relative importance of the demographic rates on population growth was similar in both hunting pressure periods. Prospective analysis revealed that the survival of prime age females had the highest elasticity (~0.5) and the survival of cubs had the second highest elasticity (~0.1). Thus, the asymptotic growth rate of the population depended partially on cub survival. Furthermore, a retrospective analysis showed that cub survival explained about 10% of the variation in the population growth rate. Sexually selected infanticide may, therefore, explain a component of the temporal variation in the population growth rate. Our study sheds light on the potential influence of individual behavior on population dynamics.

Gene Flow and Connectivity among Brown Bear Populations in Northern Europe

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We have used noninvasive genetic methods to investigate the connectivity and structure of brown bear (*Ursus arctos*) populations in northern Europe. In Fennoscandia, the demographic history of bears indicates several extinction and recolonization events, but there is poor knowledge about the present gene flow among populations in the east and west. We have collected approximately 4000 hair and fecal samples in the field and genotyped the samples using 12 validated STR markers. The noninvasive genetic sampling was performed for 6 years (2005–2010) from different core areas including Troms and Pasvik in Norway, Västerbotten in Sweden, Kainuu in Finland, and Karelia and Pinega in Russia. The genotypes showed differentiation into several clusters, with pairwise FST values between 0.05 and 0.12, but migration rates between the sampling areas were low. Heterozygosities were high, and despite a known recent demographic bottleneck, we detected signs of genetic bottlenecks in only 2 locations. In order to investigate the temporal and spatial patterns in more detail, we have analyzed 834 tissue samples from legally harvested bears from all over Finland and Russian Karelia during a larger timespan (1996–2010). The results indicate both a south-to-north and an east-to-west structural gradient that has changed over time. The distinct genetic clusters of brown bears may be explained only to some degree by isolation-by-distance, and our results suggest barriers to migration, especially between the eastern and western populations. Further, we have isolated 16 novel autosomal STRs and nine novel Y-chromosomal STRs from the brown bear genome as tools for a more extensive population genetic analysis of brown bears in northern Europe, including that of male-mediated gene flow.

Relative Individual Contribution to Population Growth in Brown Bear Populations in Sweden and Alaska

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Most models used in wildlife management assume homogenous populations and that all sexually mature individuals contribute equally to population growth. But how true is that? We used a method called "delifing" to decompose changes measured at the population level into contributions from individuals of similar sex and age and compared 2 brown bear populations in Sweden and one population in Alaska. This method utilizes data on individual survival, for example from hunting statistics, and data on individual reproductive performance, derived from a molecular pedigree, to break down an individual's contribution to population growth into a survival component and a fecundity component. The results show that, in a given year, only ~5% of the males and females in a bear population contribute positively to population growth. A given individual contributes positively to population growth on average ~2 years for the heavily hunted populations in Sweden. "Delifing" can also be used to estimate selection on qualitative traits and their contribution to population growth. Body size is an important factor contributing to survival and reproductive success in sexually dimorphic species, such as brown bears. However, our results showed that body size, despite body size being important for reproductive success, did not influence the individual contribution to population growth of bears in Sweden, This is likely a result of the management regime, where any bear, independent of size or sex, can be shot during the hunting season. The only protected segment of the population is females with dependent offspring. Survival is positively related to body size in mammals. However, due to size-indiscriminant killing of bears, this relationship seems to have been weakened in Sweden to a degree that body size no longer influences the contribution to population growth. We calculate the same statistics for a less heavily hunted population in Alaska, with similar morphological and genetic data. We assess whether individual contributions to population growth in these two regions show a similar pattern among individuals and whether the average length of the positive individual contribution lasts longer in areas heavily or lightly exploited. In addition, we explore whether there is a positive relationship between body size and contribution to population growth, as predicted from life history theory, or if it is influenced by human-caused selection in a less-exploited population.

Combining Occupancy Data and Spatially Explicit Capture-Recapture Data for Inference about Bear Population Dynamics

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Bear biologists often collect 2 types of data. The first type is relatively inexpensive and easy to obtain and is used to make inferences about abundance or occurrence over large areas and/or time periods (i.e., population trend indices). Often, however, the relationship between the index and the population parameter being estimated is not well understood. The second type is expensive, more difficult to collect, and is usually restricted to smaller areas (i.e., noninvasive DNA mark-recapture); however, these methods are more informative about demographic contributions to population dynamics and are more statistically robust. We present a framework for designing such studies and jointly analyzing the 2 types of resulting data. Such a study could, for example, include the establishment of an extensive array of hair snares where genotypes are only sequenced in some regions or a subset of time periods. Thus, for some sample locations, the data are just detection/nondetection (i.e., occupancy data), whereas at the locations where the genotypes are sequenced, the data are spatially

referenced encounter histories. Using an example from a study of the Louisiana black bear (*Ursus americanus luteolus*) we demonstrate how an extended spatial capture-recapture model could be used to analyze such data, and we discuss the benefits and limitations of the approach.

Extrinsic and Intrinsic Influences on Home-Range Size of an Opportunistic Omnivore: Climate-Induced Resource Decline or Density Dependence?

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In the Greater Yellowstone Ecosystem (GYE) the grizzly bear *(Ursus arctos)*, an opportunistic omnivore, is currently confronted with a decade-long decline of an important, high-elevation fall food source, whitebark pine seeds (WBP; *Pinus albicaulis*). The primary cause for this decline has been attributed to a climate-induced population irruption of the native mountain pine beetle (*Dendroctonus ponderosae*). Concurrent to this decline in WBP, the population growth of grizzly bears in the GYE has slowed from 4% to 7% during the 1980s and 1990s to 0%–2% during the last decade. Yet, expansion of occupied range has continued throughout the last decade and grizzly bear densities are high in portions of the ecosystem, particularly in core areas such as Yellowstone National Park. The demographic changes of an intensively studied population of grizzly bears and concomitant decline of an important food resource in the GYE represent a natural experiment to examine hypotheses regarding potentially competing influences of population density and decline of an important food source. Home-range size reflects a species' response to demographic and resource variability so our experiment was based on comparisons of home-range metrics at the individual level for the period prior to the onset of WBP decline (1989–1999) and a WBP impact period during which the tree mortality reached an apex (2007–2012). If resource availability is a greater determinant of home-range size than population density, we hypothesized that bear home ranges would increase in area during the WBP impact period, as diets shift to alternate food sources. Alternatively, if population density is driving individual space use, we expected an inverse relationship between grizzly bear density and home-range size. Due to the demands of reproduction and rearing of offspring, space allocation among females is generally less plastic compared with males. Thus, we predicted a stronger effect for males for the former hypothesis and a stronger effect for females regarding the latter hypothesis. We developed spatially explicit covariates to estimate, for each bear home range, annual grizzly bear density and proportion of WBP in the home range, corrected for WBP mortality. We used linear-mixed effects models and a dataset of 223 annual home ranges to test our hypotheses in an information-theoretic framework. Mean home range-sizes within all sex and age classes were similar during the pre-impact and impact periods. We found no relationship between home-range size and WBP availability among either sex. However, we observed a strong inverse relationship between density and home-range size, regardless of period, among female grizzly bears. We observed no relationship between density and home-range size among males. For grizzly bears in the GYE, population density may represent an intrinsic factor that is a much greater determinant of home-range size than the decline of a single important food source. Grizzly bears' opportunistic omnivore strategy likely increases their adaptability to resource variation. Further investigation is needed to determine if intrinsic factors posed by high population density constrain this adaptability.

Genetic Connectivity at Wildlife Crossing Structures in Banff National Park

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Roads fragment and isolate wildlife populations which will eventually decrease genetic diversity within populations. Wildlife crossing structures may counteract these impacts by maintaining or restoring gene flow, but most crossings are relatively new, and there is little evidence that they facilitate gene flow. We conducted a 3-year research project in Banff National Park, Alberta, to evaluate genetic connectivity at wildlife crossings. Our main objective was to determine how the Trans-Canada Highway and the crossing structures along it affect gene flow and population structure in grizzly *(Ursus arctos)* and black bears (*Ursus americanus*). We compared genetic data generated from wildlife crossings with data collected from greater populations using noninvasive genetic sampling. We detected a genetic discontinuity across the highway in grizzly bears but not in black bears. Grizzly bears detected at crossings assigned to populations north and south of the highway, providing evidence of bidirectional gene flow and genetic admixture at wildlife crossings. Genetic parentage tests showed that 47% of black bears and 27% of grizzly bears that used crossings were successful breeders. Differentiating between dispersal and gene flow is difficult, but we documented gene flow at wildlife crossings by showing a migration event followed by successful reproduction and genetic admixture. We conclude wildlife crossing structures allow sufficient gene flow to prevent genetic isolation.

DNA-Based Monitoring of Bear Recolonization and Numbers in Norway (2006–2012) Based on Hairs and Scats

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The brown bear went functionally extinct in Norway in the first part of the 20th century, but recolonization from Sweden, Finland, and Russia has led to the presence of a small population during the last decades. Monitoring of this novel population has been difficult, but for the 5 last years a nationwide survey on brown bears based on non-invasive genetic sampling has been organized in Norway. Sampling of hairs and scats in the field was first conducted in selected counties between 2005 and 2007 and then for the whole country during 2008–2012. Bear scats and hair samples have been collected by moose hunters in autumn, during track surveys for bears in springtime by the Norwegian Nature Inspectorate (NNI), during surveys of bear killed livestock and semidomesticated reindeer, and by the public reporting their findings to the NNI. DNA profiles were then determined by analyzing 8 different microsatellites and gender, and all profiles were compared to individuals in our genetic database.

The first national numbers of identified bears were 120 for 2008 (80 males and 40 females) out of which 11 (10 males and 1 female) were shot. In 2011, the numbers of identified bears peaked to 166 bears (113 males and 53 females) and 10 bears (8 males and 2 females) shot. In 2012 the numbers were 137 (86 males and 51 females) out of which 14 were shot (males and females).

During all years the total number of bears identified in Norway were 435 bears (301 males [70%] and 129 females [30%] and 5 bears with unknown sex). The known death rate for identified bears was 21% of the total number (81 males and 11 females).

Three bears radio collared in 1993 and 1994 and later lost their collars, were reidentified by DNA-analysis by hairs collected at the time of capture and found to be active near to their homeranges 18 years earlier. Our findings have revealed 4 different major core areas for bear activity that have been fairly stable over these years and that also confirm areas for bear activity known from earlier research.

The male-biased sex rate and high individual rate of new bears showing up in Norway, and their disappearance rate show that the occurrence of bears in Norway is based on dispersing animal from our neighboring countries, Sweden in the south, and Finland and Russia in the north (Finnmark County). Combined with a 19% death rate of the identified bears we can conclude that the future of a possible Norwegian bear population is highly dependent on the bear's future in Sweden and Finland/Russia.

The paper will give more details on bear numbers by year and county, and discuss experiences on the effectivity of these non-invasive sampling methods used.

Session 17
BEAR-HUMAN INTERACTIONS

Visualizing the Influence of Human Factors on Brown Bear Activity Patterns

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Large carnivores can adjust their daily activity patterns in response to environmental factors and/or human disturbance. Species such as brown bears (*Ursus arctos*) seem to respond differently across their distribution range, showing transcontinental variation in their circadian periods of activity. Whether such behavioral flexibility is due to environmental or anthropogenic factors has not been fully clarified. We used fine-scale GPS data from 106 radio-collared brown bears in 3 study areas in Scandinavia to construct daily movement patterns. We analyzed whether human and/or road density around bear locations could explain observed differences in bear activity patterns among the study areas. Almost one million GPS locations were used to calculate distance travelled by the bears every 30 min, from 225 bear-years. Preliminary analyses, not including human or road densities, showed differences in the bears' daily movement patterns in the 3 study areas, with bears being more active (i.e., traveling longer distances) during daytime in the northwestern area that included Sarek National Park. Bears were more active at night and early morning in the northeast, and more active at twilight hours in the south. Human density, which is low in Scandinavia, did not appear to influence bear movements. However, road density had a negative effect on the bears during daytime. Bears moved most in the nocturnal and twilight hours in areas with higher road density, whereas they were more diurnal in an area with no roads. Males and solitary females had similar movement patterns, whereas females with cubs moved more during the middle of the day and less during night, as previously reported. Bears became less active during daytime and more active during night with shortening days following the advance of the season. Because bear diet was similar in the study areas during the study period (the hyperphagia season, when Scandinavian bears rely on berries), we could discard food as a confounding factor. Latitude-related differences might explain the observed variation in bear movement patterns between the northern and southern study areas. However, the largest differences were due to road densities between the northern areas, which are situated at similar latitudes. Human outdoor activities, e.g., forestry, reindeer husbandry, and many leisure activities, including bear hunting, are common in Scandinavia. All of these activities use roads extensively, which seem essential in explaining why daily bear activity patterns differed the most between the northern areas. Hunting or poaching occur in both of them, but high road density in the northeastern area may increase the bears' vulnerability by providing ready access to hunters, as has been documented elsewhere. This may explain the nocturnal-crepuscular behaviour of bears in the northeastern and southern areas, compared to the road-free northwestern area, where bears were more active during daytime. In a world increasingly encroached by human development, appropriate management to limit the creation and use of all types of roads is necessary to retain high-quality habitat for large carnivores, not only to maintain movement corridors and to reduce human-caused mortality, but also to minimize human-induced disturbance that modifies carnivore behavior.

Effects of Morganza Spillway Release on Louisiana Black Bear Population Dynamics

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The Louisiana black bear (*Ursus americanus luteolus*) is a threatened subspecies of the American black bear (*Ursus americanus*) whose historic range once included Texas, Arkansas, Mississippi, and Louisiana. Today, the subspecies is restricted to 3 fragmented populations in Louisiana, one in the Tensas River Basin and 2 in the Atchafalaya River Basin. We collected DNA mark-recapture data in the Upper Atchafalaya River Basin beginning in 2007 to estimate several bear population parameters. During summer 2011, the U.S. Army Corps of Engineers opened the Morganza Spillway to divert water from the Mississippi River to prevent flooding in the cities of Baton Rouge and New Orleans. The spillway makes up >50% of Louisiana black bear habitat used by the Upper Atchafalaya River Basin population. This area was flooded for approximately 2 months. There is little known about bear response to natural disasters, such as major flooding events, so we used a multi-state robust design model to test hypotheses related to whether bears emigrated from the flooded area to non-flooded areas in 2011, using site location as state variables and estimating transition rates (Ψ). Models whereby bears emigrated from the flooded to non-flooded areas in 2011 and Ψ were hypothesized to increase for that year, received only marginal support and the effect was negative rather than positive (Ψ decreased from 0.06 to 0.01). Moreover, models with decreasing survival rates in the nonflooded areas the year after flooding (2012), as would be expected if the emigrants left nonflooded areas to return to the flooded areas, were not supported. Also, abundance estimates for non-flooded areas did not increase during the flood year, then decrease the following year when emigrants would have returned. Finally, survival rates and abundance estimates did not decrease in the flooded area, as would be expected if there was high mortality caused by the flood. These findings were corroborated with radiotelemetry data, which revealed some bears remaining in trees for weeks, and only one mortality was documented. We conclude that the flooding event did not adversely affect the adult bear population but cub recruitment may have been reduced, which will not be evident until future mark-recapture studies are completed.

Brown Bear–Human Encounters in Scandinavia: Casualties, Bear Behavior and Management Perspectives

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Bear–human encounters are increasing in Scandinavia, due to an increasing and expanding brown bear population. Bears have injured 31 people and killed 2 in the past 36 years, in contrast to no fatalities during the previous >100 years. The number of incidents was positively related to number of hunter-killed bears and the estimated bear population size in Sweden, but this only applied to armed people and not to unarmed forest users, suggesting that risk was linked to human outdoor activities, especially for hunters with dogs. Despite no apparent increase in the risk for other recreational forest users, fear of bears is increasing and tolerance for bears is decreasing among the public. A better understanding of bear

responses to humans is necessary to help reduce bear-caused injuries, which may improve people's attitudes towards bears. Since 2006, the Scandinavian Brown Bear Research Project (SBBRP) has studied behavioral reactions of brown bears when encountering humans, both in regard to human safety and the effects such encounters have on bears.

We simulated hikers and approached bears experimentally, passing them on foot within 50 m during >300 experiments. The bears reacted by fleeing, hiding in their daybeds, or hiding and then fleeing after the hikers passed. None of the bears showed aggressive behavior, we saw or heard the bears <20% of the time, and single bears and females with cubs reacted similarly. In response to the approach, the bears moved over 1 km and changed their diurnal behavior suddenly and dramatically, becoming more nocturnal for several days. Except for females with cubs, the bears also showed a rapid shift towards becoming more nocturnal at the start of the August hunting season, during the important period of hyperphagia. Bears chose resting sites with more cover during the day, when closer to human settlements, and during the autumn, all of which appeared to be responses to anticipated increased human activity. Adult brown bears selected rugged terrain >10 km from settlements and resorts during the nondenning period, in contrast to subadults. Bears were also more diurnal during hyperphagia in areas with low road densities.

We conclude that brown bears in Scandinavian avoid confrontations with humans and are generally not aggressive. They avoided humans at every spatial and temporal scale we have examined, and humans and their infrastructures influenced the bears' distribution and their diurnal behavior. These reactions to human disturbance may have fitness consequences. Our results can be used by managers to help prevent injuries by giving recreational forest users and hunters recommendations about how to best avoid risky situations, and to evaluate potential impacts of human activity on the bear population. It can also be used in information campaigns to address public fear and the reduced acceptance of the brown bear. Information campaigns targeted at hunters have probably contributed to a reduction of the number of incidents recently. To avoid bears, recreational forest users should avoid dense vegetation or make noise when entering such areas.

Modeling Brown Bear Movement Paths and Resource Selection to Mitigate the Road to Alaska's Capital

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Implementing effective wildlife mitigation strategies is important to reduce the negative effects of road development. The impacts associated with roads have been shown to increase risks to population survival as roads function as barriers to movement and gene flow, and often result in direct mortality from vehicle collisions. The State of Alaska has designed and assessed the feasibility of constructing a 78 km road to the capital city, Juneau in Southeast Alaska. We studied spatial use and habitat selection of brown bears (*Ursus arctos*) in Berners Bay, a glacially influenced watershed north of Juneau along the road corridor from 2006 to 2010. The objective of this study was to assess temporal movement patterns and identify segments along the road where brown bears have a high probability of crossing. To achieve these goals, we captured 30 brown bears (17 males, 13 females) and recorded movement data using global positioning system (GPS) radiocollars, programmed to collect locations at ~1 hour intervals. We found extensive brown bear use within 1.0 km of the road alignment, as 32% of all successful locations were within this proximity. We generated movement paths between successive locations using brownian bridge movement models to estimate the crossing location with the highest probability. This resulted in 3,074 crossing locations from the trajectories of 28 brown bears that intersected the proposed road corridor. We integrated this data into a geographic information system (GIS) framework with remotely sensed landscape factors and habitat classification data layers to develop a predictive model for road crossing areas. The current road design includes 2 wildlife underpass structures and 4 bridges over anadromous salmon streams which accounted for 20 (0.07%) and 528 (17.3%) of the crossing locations respectively. We depict how movement path probabilities and habitat selection can be used to identify and predict brown bear crossing locations that are biologically important and ultimately should assist in designing mitigation strategies that maintain landscape connectivity and population sustainability.

Potential for Visitor Use Restrictions to Reduce Grizzly Bear Attacks in Hayden Valley, Yellowstone National Park

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In 2011, two visitors were killed by grizzly bears (*Ursus arctos*) in separate incidents on backcountry trails in Hayden Valley, Yellowstone National Park (YNP). Hayden Valley is considered optimum summer grizzly bear habitat, is known to have a high density of grizzly bears, and 3 of the last 4 fatal bear attacks in the park have occurred there. Over the last 43 years (1970-2012), 23% of all backcountry grizzly bear attacks park-wide have occurred in Hayden Valley. We investigated the potential for reducing grizzly attacks in Hayden Valley by placing human behavior restrictions and seasonal closures on visitor use. The circumstances of all grizzly bear attacks that occurred in YNP over the last 43 years were evaluated to identify similarities between injuries. Different visitor use behavior restrictions that would prevent the most common situations where people were attacked by grizzly bears in YNP were then developed. Visitor use closures that would prohibit recreational activity in Hayden Valley during seasons that bears are foraging for specific food resources were also investigated. These human behavior-based visitor use restrictions and grizzly bear food-based seasonal closures were then hypothetically applied to Hayden Valley for the period 1970 through 2012 to determine how many past injuries would potentially have been prevented if these behavioral restrictions or seasonal closures had been in place during the years the injuries occurred. Human behavior-based recreational restrictions that mandate people take certain safety precautions appear to have significantly more potential to prevent bear attacks than most food-based seasonal closures that correspond to grizzly bear consumption of specific foods. Requiring backcountry recreationalists to hike in groups of 3 or more people, prohibiting off-trail travel, or requiring hikers to carry bear deterrent spray could potentially have reduced bear attacks by 70% or more. Closing Hayden Valley during the late summer period of the bison (*Bison bison*) breeding season (July 15–September 15) when grizzly bears are scavenging rut-killed bull bison carcasses could potentially have reduced bear attacks in Hayden Valley by as much as 60%. Recreational closures based on the seasonal timing of bear consumption of elk calves (*Cervus elaphus*), meadow voles (*microtus* spp.), pocket gophers (*Thomomys thalpoides*), elk thistle (*Cirsium* spp.), biscuit root tubers (*Lomatium* spp.), or yampa roots (*Perideridia gairdneri*), would have been substantially less successful at preventing bear attacks (10%–40% reduction). We also used telemetry data from radio collared bears to determine when grizzly bears were most often located in Hayden Valley. Telemetry data revealed that adult females were present in Hayden Valley throughout the entire summer, while there is some evidence that male use of the valley increased during July and August when bison rut. This analysis will help managers make scientifically informed decisions on the merits of using visitor behavior restrictions or seasonal visitor use closures to reduce grizzly bear attacks on recreationalists in the Hayden Valley area of YNP. These methods may also be useful to other public land managers for reducing bear attacks in areas where human recreational activities occur in areas occupied by grizzly bears.

Spatial Pattern of Positive Versus Negative Perceived Human–Bear Encounters: Visualizing Social Science Data

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Next to climate change, today's wildlife management is challenged with an increasing human population encroaching upon wildlife habitat. Not only people living close to wild lands, but also increasing access via roads and motorized vehicles, resource demands, and recreational activities are overwhelming current wildlife management techniques. Wildlife

management is increasingly becoming the coexistence management of people and wildlife in a diminishing wild. In recent years, the amount of human-wildlife conflicts and encounters has increased worldwide, and in most areas more interactions seem to be perceived as negative. There is a need to develop an understanding of human-wildlife encounters, their triggers, as well as positive and negative impacts on society. Additionally appropriate management monitoring methods to do so are missing, where an interdisciplinary approach incorporating social as well as wildlife research techniques seems appropriate. This study examines the distribution of positive versus negative and neutral perceived human-bear encounters across the most urbanizing region in Alaska (Anchorage, Mat-Su, Kenai Peninsula), and in the Russian Far-East (South Sakhalin Island). Data was collected via semi-structured surveys throughout the study areas in summers of 2011 and 2012. Encounter locations are geo-referenced and analyzed using Geographic Information Systems. Kernel density estimators are used to display heat maps of encounter type densities. Results reveal clustering of 2 human-bear encounter hot-spots in the Alaskan study region. Whereas in the Russian study region, minimal overlap of human-bear encounter locations exist. Further, perceptions of positive versus negative encounters vary drastically across study regions. In South Sakhalin, residents perceive only 9% of bear encounters as positive, whereas in the Alaskan study region 51% of residents perceive bear encounters as positive. These spatial results are easier understood when compared to residents perceived triggers of human-bear encounters. In Alaska, residents perceive recreation as a major trigger of human-bear encounters whereas in South Sakhalin, residents identified the competition over resources with bears as major trigger. It appears that the economic and social situation of the residents' populations play an important role on how human-bear encounters are perceived. Recreational opportunities and survival dependencies on natural resource access for human residents seem to shape dispersal and clustering of human-bear encounters across study regions. This study is a unique approach integrating scale and mapping practices for management decision makers with social science data. The methodological approach represents a basis for a citizen science based human-bear encounter monitoring program. Overall, results will improve future human-bear encounter management towards an increasing positive and sustainable comanagement of people and bears.

From the Viewpoint of Urban Bears: Using Video to Understand Human–Bear Conflict

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Human development and urbanization has led to increasing numbers of human-wildlife interactions within urban areas. Anchorage, Alaska's largest city, with almost 300,000 people, is a mosaic of large municipal parks, riparian and park greenbelts, and residential and commercial development. The urban sprawl of Anchorage borders a half-million acre state park, the third largest in the United States. Urban Anchorage uniquely provides habitat for both black bears (Ursus americanus) and brown bears (U. arctos), which coupled with anthropogenic attractants, leads to human-bear conflicts. To evaluate the fine-scale habitat use by Anchorage urban bears, the Alaska Department of Fish and Game (ADF&G) began a project in 2012 to equip urban bears with radio collars that collected location and video data. Research, management, and education staff collared 4 black bears and 2 brown bears during May–August 2012. Each collar collected Global Positioning System (GPS) locations every 20 minutes, while the black bear collars recorded 10 seconds of video every 5 minutes and the brown bear collars recorded 10 seconds of video every 20 minutes. Locations and video were recorded 24 hours a day. A total of 10,890 GPS points and 53 hours of video were collected, representing 106 bear days from 3 black bears and one brown bear. Video data has enabled us to determine the occurrence frequency of select bear behaviors, the proportion of natural and anthropogenic foods in urban bear diets, and begin to quantify fine-scale habitat use. Video clips also are being used to develop public service announcements and classroom projects designed to educate city residents and students about bear behavior and the implications of improperly storing bear attractants. These camera collars are a worthwhile asset for bear research, bear management, and public education.

Assessment of Spatial Usage of Urban Black Bears (Ursus americanus) in Lake Tahoe (CA)

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Wildlife moving into urban areas is a phenomenon observed globally. Generally, urban wildlife is considered to have a lesser ecological value than their wild counterparts. This is particularly the case when animals are thought to be reliant on garbage and other human-provided food sources. Urban bears are perceived as having reduced ecosystems services when assumed that they spend the majority of their time in urban areas pursuing anthropogenic food sources. American black bears (*Ursus americanus*) were outfitted with GPS radio telemetry in the California Lake Tahoe area to examine their use of urban and wild areas. Several urban definitions were assessed to better understand what definition is most appropriate. GPS telemetry data was used to understand home range size and habitat use. Regardless of definition, so-called urban bears spent less than 50% of the GPS locations in urban areas and thus are likely to provide significant ecosystem services. The home range is similar in size to that of wild bears in previous studies. However, I found smaller home ranges for females and larger home ranges for males compared to study results found on the eastern side of the lake.

POSTER SESSION 2
POPULATION ECOLOGY AND GENETICS

Trophic Polymorphism and Genetic Structure in a Population of Brown Bears across a Coastal-Inland Ecological Gradient

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The hypothesis that discrete intrapopulation differences in dietary niches can facilitate genetic differentiation fuels the debate on the mechanisms that generate and maintain genetic diversity. In the Stikine watershed in northwest British Columbia, salmon (*Oncorhynchus* spp.) penetrate the region along linear river systems and resource availability occurs along a coastal–inland gradient, but also across a finer-scale gradient in elevation. As such, we hypothesized the coastal-inland and elevation gradients would create an interwoven matrix of brown bears (*Ursus arctos*) that specialize on salmon or terrestrial resources. Our goal was to evaluate whether a relationship exists between discrete dietary niches and genetic differentiation in a population of brown bears. Our objectives were (1) to discern whether this population exhibits trophic polymorphisms resultant from marine and terrestrial-based dietary specializations, (2) to evaluate if these bears comprise a single random-mating population, or whether there is genetic structure within the population, (3) if there is evidence of genetic structure, to determine if distinct genetic population segments correspond with discrete intraspecific differences in dietary niches, and (4) to identify what intrinsic (e.g., sex-class) and extrinsic (e.g., elevation) factors best explain intrapopulation dietary niche variation. Genetic and stable isotope data were derived from brown bear hair collected using hair snares systematically distributed across the study area. We estimated diet using Stable Isotope Analysis in R and programs Structure and Genepop to examine genetic structure. We applied a multivariate ellipse-based approach to discern whether trophic polymorphisms corresponded with distinct genetic population segments and used a hierarchical Bayesian modeling technique to evaluate alternative models of the influence of intrinsic and extrinsic factors on bear diets. Our results show that trophic polymorphism within this bear population reflects dietary specialization on salmon or terrestrial food resources. We found genetic structure within this population, not a single random-mating population. We also found

that both intrinsic and extrinsic factors influence intrapopulation diet variation. Our work provides new insights into the ecological drivers of life history diversification and offers an alternative mechanism to the traditional concept that genetic differentiation requires physical separation of populations.

Detection Biases in an American Black Bear DNA Capture-Mark-Recapture Study

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Precise wildlife population estimates are necessary for understanding population trends and making informed management decisions. Hair traps are a common method for estimating American black bear (*Ursus americanus*) abundance; however, their efficacy has received little attention. We compared DNA data collected from hair traps using 2 sampling designs tested in southern Missouri during 2011 and 2012 and compared parameter estimates using capture-recapture models. We also assessed movement patterns of GPS-collared bears and images from remote cameras to estimate detection bias. In 2011, we used a grid (29,775 km^2) comprised of 100 km^2 cells and allocated 378 hair traps proportionate to the number of historical bear sightings per cell. In 2012, we established 403 hair traps in five 210 km^2 sampling arrays with 2.6 km^2 cells, each cell containing one trap. Mean nearest-neighbor distance between traps was 3.6 km in 2011 and 1.0 km in 2012. We established 100 remote cameras each year at hair traps located within GPS-collared bear home ranges. Each year traps were checked and lured every 10 days for 6 occasions from June–August. We identified all bears with GPS collars using DNA from tissue or hair samples collected during immobilization. In 2011, microsatellite marker analysis of hair samples revealed 27 unique individuals (14 males, 13 females) captured at 10% of hair traps. Of 8 events where a camera detected a collared bear at a trap, 38% resulted in hair capture and identification of a collared bear. In 2012, we identified 90 individuals (36 males, 54 females) captured at 23% of traps. Of 48 events where a camera detected a collared bear at a trap, 35% resulted in hair capture and identification of a collared bear. Mean number of bears detected per session increased markedly from 7 (SD = 1) in 2011 to 28 (SD = 6) in 2012, with a similar increase in capture probability from 0.17 (SD = 0.02) to 0.26 (SD = 0.06), respectively. Preliminary results suggest trap spacing and density, as well as heterogeneity in bear behavior, are important for estimating detection parameters with high precision. Accounting for detection biases is challenging but is an important consideration when developing monitoring programs and management strategies.

BEHAVIOR

Spatial and Temporal Variation of Visits to Waterholes by Andean Bears (*Tremarctos ornatus*) in the Tropical Dry Forest of Northwestern Peru

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Water is limited in the tropical dry forest of northern Peru; few waterholes remain accessible to large mammals such as the Andean bear (*Tremarctos ornatus*). We located waterholes throughout our study site (237 km^2) and deployed camera traps at them to examine, for the first time, spatio-temporal patterns of waterhole visits by bears, in 2 distinct seasons: spring-summer (October–March, 'summer'), and fall-winter (April–September, 'winter'). We found 12 waterholes, but to ensure robustness of results, we've analyzed data from just the 7 waterholes that had water year-round and were sampled on ≥365 consecutive days from June 2008 to February 2013 (8431 camera-days). Each detection at the waterholes was considered independent (n = 1117), and bears were identified from their facial markings. Thirty bears were detected: 10 adult males, 9 adult females, 1 sub-adult of unknown sex, and 10 cubs.

Overall detection frequency of bears differed between summer and winter (2.91 ± 0.9 detections/bear/100 camera-days versus 0.66 ± 0.24 events/bear/100 camera-days). Higher visitation to waterholes during the summer coincides with the breeding season and the fruiting season of sapote *(Colicodendron scabridum)*, a key food resource for bears in this habitat. The yearly average detection frequencies of males, and females without cubs, were similar (1.79 ± 0.16 events/bear/100 camera-days, 1.77 ± 1.12 events/bear/100 camera-days, respectively), but the average detection frequency for females with cubs was lower (0.54 ± 0.33 events/bear/100 camera-days), which indicates an avoidance to waterholes. This was also noted in the daily activity patterns of females with cubs. Bears were detected mostly during the day (91.8%), with some nocturnal activity (8.2%); peak visitation by males was at 0800 h, while females without cubs visited waterholes most often at 0600 h and 1600 h, and visitation by females with cubs peaked at 1600 h. This possible avoidance between males and female with cubs at waterholes may be a strategy to prevent aggression or infanticide, which has been reported in other ursids.

An average of 13.9 ± 2 (SD) bears were detected per waterhole, suggesting that home ranges of Andean bears in this habitat overlap greatly, more in summer (11.9 ± 1.4 bears/waterhole) and less in winter (7.9 ± 3.1 bears/waterhole). This overlap at waterholes was greater among males (6.4 ± 1.1 per waterhole) than females without cubs (4.3 ± 0.5 per waterhole) and females with cubs (3.4 ± 1.5 per waterhole). Males were detected at more waterholes in summer than winter (6.6 ± 1.8 versus 1.8 ± 2), but there was less seasonal difference in the number of waterholes visited by females without cubs (3.7 ± 1.2 versus 2 ± 0.7) and females with cubs (2 ± 0.6 versus 1.3 ± 0.5). Greater seasonal variation in use of waterholes by males may reflect their search for breeding females. Perhaps waterholes are used as locations to communicate with conspecifics, which may be particularly important during the breeding season.

Our data show that, as expected, Andean bears visit waterholes in the tropical dry forest. However, their visits to waterholes vary in ways that reflect season, time of day, and demography, suggesting that waterhole visitation is influenced by factors extrinsic and intrinsic to the bears themselves.

A Comparison of Activity Patterns and Movements of GPS-Collared Captive-reared and Wild Brown Bears *(Ursus arctos)* in Greece

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The activity patterns and movements of 2 male brown bear cubs orphaned in separate incidents in Greece in April 2011 were compared to those of 2 wild bears collared with GPS Iridium satellite radio collars. The orphan cubs were raised in captivity and released in the same winter den in December 2012. Data were collected on activity and movements of the orphaned bears after they emerged from their winter den and compared to those of 2 subadult wild bears. In this paper, we present comparative data on daily and seasonal activity and movements of the bears, distance from known human activity centers and roads, and describe the movements of the 2 captive-reared bears in relation to one another during their first active season as wild bears. We also discuss the conservation implications of this first release of orphaned cubs in Greece using a standardized captive-rearing and release protocol.

Is There "Somebody"? The Relation Between Personality Dimensions and Individual Life Story of Subadult Brown Bears

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The paper considers the ontogeny of individual behavioral phenotypes in relationship with social interactions and life story of individuals we observed in 71 bear cubs organized in family groups during the first 1–3 years of their lives, between 2001 and 2013 in a rehabilitation center in the Romanian Carpathians. Our attempt was to investigate how life stories of individuals and social interaction between individuals influence their individuality development and how during this process individuals develop a personal identity. The method adopted was the scoring adjective method with directly observing the behavior. We adopted 60 adjectives mainly from Fagen and Fagen (1996). In order to have a measurable rating system at each individual, we generated pairs of bipolar dimensions, such as aggressive–submissive or confident–fearful. A Multiple Factor Analysis and a Principal Component Analysis revealed the existence of clusters of large correlation coefficients (minimum 0.35) between subsets of variables, suggesting that those variables could be measuring aspects of several different personality dimensions. By reducing the data set from a group of interrelated variables to a smaller set of factors, we obtained 10 personality profiles, testing our assumptions. As part of the study we tried to find out whether the life history of the cubs influence in any way the development of their personality profiles. For that we recorded the following variables: 1. Did the cub interact with other cubs during the first year of his life? 2. Was the cub the offspring of a problematic female? 3. Was the bear kept more than 5 months in captivity before rehabilitation? Results of the statistical analyze of the data revealed that there is a strong relation between life history of bear cubs and their personality profile development.

Intrafunctional and Extrafunctional Marks of Brown Bear

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N.P. Naumov's (1973) conception of biological signal fields (BSF) is continuing to induce the interest of researchers which are working in the sphere of mammal behavior ecology (Nikol'skii, 2003). The scientists offer the new notions and terms, and the problem of forming terminology unification is arising. The report authors propose their own version of this problem solution. This version is based on the longtime investigation of brown bear *(Ursus arctos L.)* BSF. Any notions from hierarchical raw of nature levels (ecosystems/populations/communications, BSF/signals and marks/signal carriers) are argued.

Alive systems are discrete, their disconnection in space and time are surmounted by some mechanisms. The distribution of signals and the interchange by signals (nongenetic information) are argued here.

Integration of individuals and populations is provided by the communicative behavior, BSF, information environments (Tembrock 1977). BSF is the system-ordered aggregation of distributed in space and time signals. BSF has the nature of field and information environment and provides the integral functioning of biosystems of the individuals, populations, and cenoses levels.

The "signal" and "marks" definitions are offered. The "marks" and "marking behavior" notions are widely used in the ethology and behavior ecology publications, but their interpretations are not univalent. The bear "marks" correspond to several different forms of bear dendroactivity in fact (Puchkovskiy 1998, 2005). We propose to divide the marks into two great categories: intrafunctional (IM) and extrafuncional marks (EM). IM are specialized marks (Naumov 1973, Tembrock

1977), which have the communication significance for integration of populations and biocenoses. EM are the information source about the investigation or monitoring object for researcher. Under the real level of our knowledge the IM and EM interpretations are not identical.

Extrafunctional marks are divided into some types, which are combined into 6 groups in our studying: injuries, surface (ground) marks, marks of recording year, marks of last years, elementary marks, combined marks. Their analysis permits us to estimate the brown bear populations properties noninvasively (Puchkovskiy 2013).

The special ingredients of environment are the marks carriers (MC). They are, basically, the trees, terrestrial vegetation, soil, and earth near the bear tree in the forest ecosystems.

Bear Ethology Around Romania (B.E.A.R.)—Case Study Brasov Area

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Starting from 1994, radio VHF telemetry, and since 2005, GPS telemetry systems offered us data about the size of territories and types of activity for the bear population in Romania. Over the years, we've monitored a total of 60 bears: 26 in natural habitats and 34 in anthropogenic habitats. The main results from the territories are that the smallest territories belong to females with cubs which feed on garbage (about 500 ha/year) and the largest territories belong to young males (3 years) in search of their own territories (about 70,000 ha/year). Most bears have been registered having territories between 4000 and 9000 ha. From 2004 till 2012, a number of 102 bears have been relocated from the anthropogenic habitat back into the wild and natural habitat. Meanwhile, we recorded 37 direct events of conflicts between humans and bears in which 5 people were killed and 31 people were injured. The paper we prepared presents the results of the research: the size of the territories the bears have during one year and the human–bear conflicts in Brasov and Prahova Valley area. From all the direct conflicts between bears and humans, 80% were recorded in anthropogenic habitats and 20% in natural habitats. In spite of all these conflicts, the general population of Romania and even the residents from areas where there are direct interactions still love the bear and have a positive attitude.

Intraspecific Communication of Andean Bears in the Peruvian Dry Forest

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The Andean bear (*Tremarctos ornatus*) is vulnerable to extinction across their range in the Andes. Despite their charismatic qualities and vulnerability, T. ornatus remain one of the least known species of Ursidae. One area in particular that has received little attention is the bears' marking behavior. To date there have been no long term studies conducted on the intraspecific communication of Andean bears. In this study, we test the hypothesis that Andean bear show preferences for leaving marks along ridge lines on certain species of tree. Data on marking behavior was collected over a 30-day session spent in the Peruvian dry forest; 57.6 km of bear trail were surveyed and marks were documented. A total of 18 rub posts, 14 bear prints, and 2 scratch marked trees were found. The location, characteristics, and other physiognomic parameters surrounding these marks were recorded. In a previous study carried out in the Ecuadorian cloud forests, bears showed preference for marking Manzano Blanco (*Guarea* sp.), Manzano Rojo (*Guarea* sp.) and Yalte (*Ocotea infraveolata*). These tree species possessed resinous properties, which could aid in the bears' communication. However in extreme habitats such as the dry forest, where bears do not have the same diversity of tree species, we found that bears marked on small shrub

species such as Cerezo *(Muntingia calabura)*, Lucraco *(Waltheria ovata)* and Capparidaceae (*Capparidastrum* sp.) with an average height of 107 cm, and they did not use ridge lines. In contrast, the majority of marks were found near water holes of lower elevation, sites that are considered key for bears' survival, and thus highly visited. Marking trees, selection of species, and their location are crucial to the bears' communication system and their survival. The loss and endangerment of these plants, shrubs, or tree species could impede their ability to effectively communicate making it difficult to find other conspecifics during the breeding season. This study presents the first insight into how bears of the Peruvian dry forest communicate with each other and could assist in the future study and the conservation of this species.

Social Interactions and Their Influence on Feeding Behaviour of Grizzly Bears along a Salmon River in the Northern Yukon

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Social status affects resource access and feeding efficiency of individuals for many species of mammals. The result is greater energy intake, potentially accompanied by increased fitness, for dominant individuals relative to subordinate individuals. As part of a broader research project, we examined the social dynamics of grizzly bears congregating along the Fishing Branch River, Yukon, to assess whether dominance-dependent resource acquisition could compound potential effects of bear viewers on these bears. We investigated whether (1) a dominance hierarchy existed among grizzly bears along the Fishing Branch River, (2) the nature of social interactions among these bears (i.e., aggressive or passive interactions, age/sex class involvement in interactions, and minimum distance maintained between individuals in passive interactions), and (3) whether dominance status influenced bears' fishing behaviour. Although a general dominance hierarchy was evident among the grizzly bears using the Fishing Branch River, social status had no measurable effect on the fishing behaviour of these bears. Above-average salmon abundance and few conspecifics using the river minimized competition driven by resource guarding. Because of this ecological context, all bears, regardless of social status, had temporally or spatially unimpeded access to salmon along the river. However, we expect dominance status to influence the feeding behaviour of these bears in years with less abundant salmon. Hence, we recommend monitoring dominance and feeding behaviour of bears along the Fishing Branch River during a year with low salmon abundance. Because bears during our study reduced their fish consumption when viewers were present, further reduction in consumption during low salmon years could pose serious energetic consequences for subordinate bears.

Some Aspects of Locomotory Stereotypies in Spectacled Bears (*Tremarctos ornatus*) and Changes in Behaviour Following Relocation and Dental Treatment

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The behaviour of two spectacled bears (*Tremarctos ornatus*) was studied at Wrocław Zoo (Poland), where they were housed in a very small outdoor enclosure, and then in a separate study following transfer to a large, naturalistic exhibit at Chester Zoo (UK). The studies combine to form an opportunistic "experiment" on the effects of transfer on zoo animals to assess any changes in their behaviour and welfare following the move. In part one of the study, at Wrocław Zoo, the median amount of time devoted to stereotypical movements was 57 min/h. There was no significant difference in the amount of the time each bear spent stereotyping ($P < 0.9$). Shortly after arrival at Chester Zoo, behavioural repertoire of one bear improved and abnormal behaviours were eliminated from it. Conversely, the other one still performed high levels of stereotypic head-rolling and pacing in a circle and was using a very limited area of the enclosure. Signs of dental problems

were subsequently observed in both bears, and so a dental examination was carried out resulting in multiple extractions. Following dental treatment, the amount of time that the bear with ongoing behaviour problems spent stereotyping reduced significantly, and foraging increased. Before dental treatment he spent 55% of the time doing stereotypic behaviour that was reduced significantly to 16% in PT1 ($\chi^2 = 717.9$, df = 1, $P < 0.000$). There were statistically significant increases in time spent feeding during the two post-treatment periods, compared with the baseline (PT1 feeding: $\chi^2 = 23.65$, df = 1, $P < 0.000$; PT2 feeding: $\chi^2 = 16.61$, df = 1, $P < 0.000$). Whilst there are several factors that could have contributed to the observed reduction in stereotypy, it is clear that further investigation is needed into the effects of pain and physical condition on stereotypy and other abnormal behaviours in bears and other animals.

Cross-Institutional Study on Captive Bears Welfare: a Case of Poland

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Bears are very popular in zoos and some species reproduce well in captivity. Their welfare is of concern in many European countries. Zoos that are members of the European Association of Zoos and Aquariums (EAZA) are obliged to address EAZA's Code of Ethics that states that zoos promote an interest in animal welfare and cooperate on improving welfare standards. Nevertheless the ethics of bear keepings continues to be compromised with the large numbers of bears that continue to be kept in concrete enclosures and in an environment that either lacks enrichment or is spatially limited and of poor complexity. Welfare evaluation processes can help understand basic animal welfare problems that can develop improved standards. Evaluation can be an obvious help in identifying and solving animal welfare issues before small problems grow.

In the study conducted in Poland (2007–2009) data on animal welfare were collected using questionnaires based on the Five Freedoms concept. A total of 36 questions were addressed in order to obtain qualitative and quantitative data on bear welfare. The ranking of keeping conditions was created based on the total count of evaluation points for each enclosure. Additionally, detailed information on each individual was collected regarding age and origin (where such data available) and years spent in the enclosure and relation to other individuals in the group (where applicable). Behavior was scanned with all-occurrences recording up to 6 hours per enclosure. Each location was visited 3 times giving the total number of 342 observation hours. Stereotypic movements were recorded separately as being of special interest in this study and important welfare indicator.

The brown bear continues to be the most common bear species in captivity in Poland as it was at the time of the study. Of the 30 brown bears of known age 19 were below 20 years of age. For the 12 Asiatic black bears that had a known age, eight individuals were above 20 years old. All individuals of the remaining species were above 20 years of age (Malayan sun bears, polar bear and spectacled bear). Studied bears (N = 54) were mostly born in zoos (38 individuals), donated or obtained from circuses (10 individuals), confiscated by customs (2 individuals), wild born (2 individuals) or unknown origin (2 individuals). The exhibition of bears in Poland is common in small concrete enclosures. Of 30 enclosures at the time of the study, about half were of the concrete pit type. Occurrences of stereotypic behaviors were observed in all individuals in the amount ranging from 0.5 to 88.3% of observation time (median 17, 8%). The results showed a significant difference in time devoted to stereotypies in relation to species ($P = 0.04$). Brown bears were more likely to perform stereotypic behaviour than Asiatic black bears. There was a significant correlation between space and stereotypies ($r = -0.43$, $P = 0.03$). Higher values of space variable (bigger enclosures) were accompanied by a lower level of stereotypic behavior. The correlation between the level of stereotypies and the ranking (the overall assessment of the keeping conditions) was R = 0.58, statistically significant for $P \leq 0.05$.

Understanding Nervous Black Bear Behavior

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When black bears (*Ursus americanus*) get nervous, they look ferocious, and many are killed unnecessarily for behaviors that include bluff-charging; lunging, blowing, and slapping the ground; blowing and slapping trees; or blowing and chomping (also called jaw-popping). These behaviors are often misinterpreted as aggressive. However, in hundreds of occurrences, these behaviors have invariably been defensive and harmless in our experience of working closely with wild black bears, including habituated and food-conditioned individuals. Since we know of no attacks following hundreds of these displays, we call them nervous bluster. When we see any of these behaviors, we know there is no danger of attack under the existing circumstances. We give such bears a couple meters or more of space to let them calm down. We have never had a black bear come after us and hurt us in 46 years of study. This includes accompanying mating pairs and mothers with cubs for 17 of those years. We have found that bears exhibiting these behaviors are easily chased away. All slaps and nips we have received occurred when we initiated contact. We present videos of black bears displaying these behaviors and discuss contexts and nuances.

Human Access Management in West-Central Alberta: Implications for Movement and Behaviour of Grizzly Bears (*Ursus arctos*)

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Trails and roads have been identified as key threats to grizzly bear persistence in Alberta. Quantifying human use of access routes and associated responses in bear behavior gives important insights into human-bear conflict and means of mitigating bear mortalities. With the use of remotely triggered trail cameras alongside concurrent GPS grizzly bear location data, this study aims to identify how grizzly bears respond to varying magnitudes and types of human-use across a heterogeneous landscape. Since May 2012, 43 trail cameras have been deployed in the Cadomin/Robb region of west-central Alberta to monitor frequency of human, ungulate, and carnivore use of several trail types. Concurrent GPS data on 6 satellite-collared bears provide information on movement, habitat selection, and, when combined with the camera data, space use in relation to different levels of human access. Preliminary analysis of the camera data indicates high levels of variation in the magnitude of human use, both spatially and temporally. A clear disparity in type of use was observed between park and crown land, the former showing a range of nonmotorized use and the latter almost exclusively ATV use. Cameras also were successful at capturing wildlife use of trails. Future analyses aim to combine human-use data with grizzly bear movement data within a statistical modeling framework to assess bears' responses to human-use across the landscape. Wildlife camera data will be used to test and design novel multispecies monitoring techniques using an occupancy framework.

BEAR-HUMAN INTERACTIONS

Spatial Analysis of Bear/Human Conflict Lake Tahoe (CA)

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Bear/human conflict has been on the rise in North America over the last 10 years, and this trend is evident in California's Lake Tahoe area. I investigated occurrences of bear/human incidents over a 5-year period in Lake Tahoe to examine the geographic distribution of incidents, define hotspots, and assess whether specific spatial features influenced the likelihood of a bear incident. Restaurants, schools, and trash transfer sites were used as a proxy for attractants; streams were used as a potential travel corridor; wetlands were considered preferred habitat; and 3 classes of forest (coniferous, hardwood and mixed) were considered good cover types to aid retreat after attempting to leave a developed area. Locations for incidents from 2007¬–2011 were gathered from five different law enforcement and NGOs. All incidents were cleaned and geocoded (ArcGIS10). A total of 2807 incidents were used for analysis. Euclidean distance to each incident was taken to each geospatial feature. Over 17,000 bear/human conflicts were reported over the 5-year period, with several agencies not reporting for the full 5 years. Workload is not distributed equally across agencies, and the NGO operating in the area appears to deal with the bulk of the bear/human conflict. The hotspot analysis showed that especially the north shore had several areas where conflict appears to be most intense. Proximity to the potential attractants did not increase the probability of incidents. Most noteworthy is that proximity to wetlands and streams increased the probability of bear/human conflict. Wetlands demonstrated the strongest association in generating bear conflict.

Human–Sloth Bear Conflict in Mount Abu Wildlife Sanctuaries and Mitigation Strategies

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We studied the human-sloth bear conflict in Mount Abu Wildlife Sanctuary, Rajasthan, from June 2007 to July 2011. Information on human casualties by sloth bears was collected in a predesigned format from forest department records, newspapers, hospitals, and also through interacting with the affected people or their family members. From 1997 to 2011, there were 63 bear attacks on people in and around Mount Abu Sanctuary. Males were attacked more (68%) than females (21%) and children (11%). Thirty-seven incidences (59%) occurred in forests, 17 (27%) in crop fields, and 9 (14%) in villages. Most of the attacks were caused by a single bear (49%), followed by 2 bears (27%) and 3 bears (21%). In 2 cases 4 bears were responsible for mauling. Maximum casualties occurred in winter season – 24 cases (38%), followed by monsoon – 21 (33%), and summer – 18 (29%). Most of the victims were in the age group of 21–30 years (33%), and 10–20 years (24%) followed by the age class 31–40 years (22%) and rest age group victims were less than 20%. The maximum number of attacks took place during the evening (1500–2000 h, 35 attacks) and morning (0500–1000h, 13 attacks), when the bears were active for foraging. Damage to agricultural crops by bears was of varying extent. Mitigation strategies to reduce the conflict have been suggested.

Habitat and Crop Rampage Behaviour of Sloth Bear in Andhra Pradesh, India

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The Indian Bear, *Melursus ursinus ursinus* (Shaw) is common throughout India. Despite its long association with human beings, due importance was not given to the studies on its biology. Bear is protected under schedule I of Indian Wild life Protection Act, 1972. Bears are widely distributed in almost all types of forests (Pocock 1941). Bear rampages on crops are well known, particularly on tuber crops adjacent to forests, and there are also attacks on human beings of tribal hamlets and villages in the vicinity.

The bears in the wild do not get food on specific schedules. Hence ,the schedule of feeding is very random, and the bears themselves are not sure of the type of food they are going to have on the search. Basically they are nocturnal going on searching food about 2 hours before dusk and up to about 2 hours after the dawn. There has been no report on the quantity of food consumed in the wild and also on the digestive efficiencies of food items by bears. On experimenting with different combinations of food in captivity, Geoffrey and Robins (1990) found no difference in the digestive efficiencies and regarding the quantities.

In Andhra Pradesh, 18 districts were identified with sloth bear population among 26 districts. Due to habitat destruction for formation of express highways and other anthropogenic activities their habitat loss leads to starvation. Present studies were carried out at Badvel in Kadapa and Veeragattam villages and Srikakulam districts. The studies were carried out in a scientific manner with the involvement of local inhabitants to identify the reasons for habitat loss, and to identify which crops were rampaged.

The stereotypical behavior of the sloth bears during pre-feeding and post-feeding phases have also been observed. The prefeeding phase was dominated by swaying behaviour and postfeeding phase by combats. The combats occurred between (i) male and male; (ii) male and female and (iii) female and female.

Living in Bear Country: Ecological Study of Human–Brown Bear Conflicts in Sangjiangyuan Area, Tibetan Plateau, China

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Brown bears (*Ursus arctos*) are the largest carnivores on Tibetan plateau. Human-bear conflicts such as damaging houses and killing livestock have become serious problems in the past decade and retaliatory huntings were increasing. Understanding ecological process of them will be the first step in making a conservation plan.

We conducted sign surveys and community-based interviews since 2009. Three bears were captured and tracked with GPS collars, which was the first time a brown bear was collared in China. Depending on bear activity intensity, we also designed strip transects for a prey survey since 2011. In addition, 12 electric fences were set for a pilot houses-protection experiment.

GPS-collar data suggests both male and female bears had ~2,000 km^2 annual home range area, which is really large for females compare to other studies. Twenty-seven percent of feces contained human-related food and the main natural food is marmot, pika, and blue sheep. The peak of damage to houses occurred in May and August, when local people moving

to summer range and leaving their food storage unguarded while most marmots were hibernating. In addition, 77% of livestock killing happened in September and November, right before bears went into hibernating. Binary logistic regression shows that conflicts are significantly correlated to the efforts people made to look after their houses.

The study indicates that brown bears are more likely to seek human-related food when the availability of natural food drops down. Therefore, measurements should be taken to protect bears' prey and to take care of houses, such as building electric fences partially reduced human-brown bear conflicts.

Assessment of Human-Sloth Bear Conflicts in Gujarat State

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The state of Gujarat in northwest India reportedly supports a high density of sloth bear (*Melursus ursinus*) in its central and northeastern region. Local communities inhabiting the region depend on forest products for much of their livelihood. Human activities and encroachment both within and outside protected areas result in high frequencies of sloth bear attacks on people, and relatedly, restricts movement of sloth bears and other wild animals among patches of suitable habitat. We collected information on sloth bear attacks from January 2008 to December 2012, using forest office records and interviews with human victims. We obtained reports of 108 incidents of humans attacked by sloth bears, including 2 human fatalities. Most attacks (53.7%) occurred in Central Gujarat followed by North Gujarat (23.14%). All victims were adults (21–40 years), of which 72.22% male and 27.78% were female. More bear attacks occurred near villages and around protected areas. All recorded attacks occurred in the morning between 06:00 to10:00 hrs and during the cooler months (Nov–Jan) of the year, as during these months more fodder is available and local people lead their cattle on the fringes of forest for grazing. Minimizing attacks on sloth bears will require that local communities are informed of where, and under what circumstances, sloth bear attacks are likely. We recommend that landscapes with acute conflicts are managed and modified to reduce human-bear confrontations. We suggest implementing measures of adaptive land-use management providing local people with information as to where, and under what circumstances, sloth bear attacks are likely. Compensation schemes are already there by the state forest department, but due to a low literacy rate, the local community is not aware of these schemes, so we distributed preformatted applications among the villages and informed them of what kind of cases are eligible for consideration under this scheme. These steps are likely to improve human safety in areas used by of sloth bears and continued human-bear coexistence in the bear occupied areas of Gujarat.

Demographic and Spatial Consequences to Dietary Reliance on Crops for the American Black Bear (*Ursus americanus*) Using Isotopic Analysis

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We have the unique opportunity to investigate the dietary reliance on agriculture of a recently established population of American black bears (*Ursus americanus*) that are living in what is considered marginal habitat at the periphery of their range in northwest Minnesota. We used stable isotope analysis to compare the isotopic signatures of bear hair samples (bear years = 86, $n = 47$) to potential natural food options (plants, fruit, nuts, whitetail deer, ants) and agricultural food options (corn and sunflowers). We used the relative abundance of ^{13}C versus ^{12}C to differentiate the percentage of diet associated with C_3 and C_4 plants (notably corn: $d^{13}C$: x = −12.06) versus natural bear foods ($d^{13}C$: x = −26.95). We discovered that farmers' application of nitrogen fertilizer on sunflower fields provided a major source of $d^{15}N$ (sunflowers: $d^{15}N$: x = 9.86) enabling us to differentiate bear use of this food source from natural foods (e.g., fruit, nuts) in the late summer and fall ($d^{15}N$: x = −1.28). We tested relationships between crop use reflected by isotopic signatures high in $d^{13}C$ and $d^{15}N$,

with demographic (e.g., weight, age), health (e.g., fat thickness) as well as spatial data (e.g., home-range size, habitat use, landscape fragmentation) obtained from GPS collars on the bears from which we obtained hair samples. We used mixed models with a random effect for individual and included sex of the bear in each model. As expected, crop use (as measured by GPS locations) and body fat had positive significant relationships with isotopic values consistent with crop use. Results also suggest that dominance may play a role in crop use. Larger individuals used both cropfields and oak stands more frequently than smaller individuals. Spatial data showed that bears utilizing crops had access to calorie-rich foods and also conserved energy by travelling less. Understanding a population's crop use and its consequences has management implications for bears living in agricultural matrices around the world.

Does Despotic Behavior or Food Search Explain the Occurrence of Problem Brown Bears in Europe?

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Bears are usually considered to approach settlements in search of food, but this paradigm ignores interactions among bears. We analyzed the age distribution and body condition index (BCI) of shot brown bears in relation to densities of bears and people and whether the shot bears were killed by managers ("problem" bears; n = 149), in self-defense (n = 51), or hunter-killed nonproblem bears (n = 1896), between 1990 and 2010. We compared patterns between Slovenia and Sweden, i.e., areas with and without supplemental feeding of bears, respectively, based on 2 hypotheses. The food-search/food-competition hypothesis (I) predicted that problem bears would have a higher BCI (e.g. exploiting easily accessible and/or nutritious human-derived foods) or lower BCI (e.g. because of food shortage) than nonproblem bears, a positive correlation between BCI and human density, and a negative correlation between problem bear occurrence and seasonal mean BCI. Food competition among bears predicts an inverse relationship between BCI and bear density. The safety-search/naivety hypothesis (II) predicted no relation between BCI and problem/nonproblem bears and human density, and no relation between problem bear occurrence and seasonal mean BCI. If food-competition or predation avoidance explained bear occurrence near settlements, we predicted younger problem bears over nonproblem bears, and a negative correlation between age and human density. However, if only food-search explained bear occurrence near settlements, we predicted no relation between age and problem/nonproblem bear status, or between age and human density. We found no difference in BCI or its variation between problem and nonproblem bears, no relation between BCI and human density, and no correlation between numbers of problem bears shot and seasonal mean BCI for either country. The peak of shot problem bears occurred from April to June in Slovenia and in June in Sweden, i.e. during the mating period when most intraspecific predation occurs and before hyperphagia during fall. Problem bears were younger than nonproblem bears and both problem and nonproblem bears were younger in areas with higher human density. These age differences, in combination with similarities in BCI between problem and nonproblem bears and lack of correlation between BCI and human density, suggest safety-search and naïve dispersal to be the primary mechanisms behind bear occurrence near settlements. Compared to adults, younger bears are less competitive, more vulnerable to predation, and lack human experience. An alternative explanation for the lack of difference in BCI between problem bears and nonproblem bears may be that in adverse ecological conditions, even well-nourished bears may experience hunger and thus approach people. BCI was inversely related to the bear density index in Sweden, whereas no correlation was found among Slovenian bears, suggesting that supplemental feeding may reduce food competition in combination with high bear harvest rates. Bears shot

in self-defense were, as expected, older and their BCI did not differ from that of nonproblem bears. Reasons other than food shortage apparently explain why most bears are involved in encounters with people or viewed as problematic near settlements.

The Use of Pipelines by Alberta Grizzly Bears

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Oil and gas pipelines are prevalent features on the Alberta landscape. Limited research has occurred on grizzly bear response to pipelines in Alberta. In the first year of this project, we set out to determine whether grizzly bears selected pipelines and to examine habitat use and movement patterns on pipelines. Grizzly bears were captured and collared from 2006 to 2012. Collars were programmed to obtain a location every hour of the day from 1 May to 30 October. We used pipeline data obtained from Alberta Energy and road and seismic data provided by Alberta Environment and Sustainable Resource Development (AESRD). Since the raw pipeline, road, and seismic line data were all linear features and did not represent the true widths or areas on the landscape, linear features were buffered with mean widths specific to each linear feature type as well as the average collar error and were converted to polygons using a GIS. To determine if use of linear features occurred differently from expected based on availability, we followed the methods of Manly et al. (2002) and used Chi-square tests, selection ratios, and confidence intervals. The results indicated that grizzly bears used roads, road-pipelines, and pipelines significantly more than expected. Seismic lines were used no differently than expected. Selection patterns for pipelines, road-pipelines, and roads varied by linear feature, age-sex class, and season. To investigate grizzly bear activities while on pipelines, we visited 211 grizzly bear collar locations on pipelines in 2012. Bear sign was not observed at 65% of the sites and suggested that bears moved through the area without stopping for a period of time. Locations where bear sign (grazing, root digging, disturbed ant hills or wood, disturbed wasp nests, disturbed berry shrubs, kill sites or beds) were observed indicated that grizzly bears will use pipelines for a range of foraging activities, with anting being the most common. A kill site and a bed were observed at only one site respectively. We analyzed daytime hourly step lengths to investigate grizzly bear movement on pipelines and other linear features. We used a general linearized model, using a log link, clustered by bear. Movement rates of grizzly bears were significantly faster on roads, road-pipelines, pipeline, and seismic lines compared to non-linear habitat. Fast rates of movement suggest that linear features served as movement corridors for grizzly bears in our study area. Age-sex class and period of the day were also significant predictors of movement rates. As oil and gas development continues to expand in grizzly bear habitat, it is important to gain an understanding of the potential impacts of pipelines on grizzly bears. Results from this research will help resource managers to understand and predict grizzly bear response to pipelines, assisting with resource management and recovery efforts of grizzly bear habitat in Alberta.

Conflict Mitigation Model for Human–Bear Conflict Management in India

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Human bear conflict is emerging as major challenges to conservation efforts as human population grow and compete with bears for space and resources. India is home to 4 of the 8 species of bears in the world and these 4 species exist across 26 states in India, thus qualifies as an umbrella species. The increasing pressure on bear habitat reveals an urgent need to look at long-term conservation strategies for bears and associated wildlife and habitats. The National Bear Conservation and Welfare Action Plan, released at the IBA 2012, brings together swathes of information on the distribution, status, and habitat of species or groups of species, and identifies the gaps in knowledge and conservation priorities. Bear management issues in India, esp. in conflict hit areas, ranges from protecting bears and their habitats to managing the increased incidences of bear-human interactions and dealing with local communities who are sharing the resources with bears. A localized conflict

mitigation model was built to unite with the goal of the National Bear Conservation and Welfare Action Plan for the areas with high 'human–bear conflict'. The model would cater to region/state issues through participatory processes which would ensure ownership and improve prospects for implementation and ultimately lead to sustained efforts. The model includes assessment of issues such as degree of conflict in the areas; major reasons for conflict; season in which conflict is at its peak; approach of local or state level organizations and departments to minimize conflict and initiatives taken to reduce conflict; awareness level among the locals living in the proximity to the forest and of households prone to conflict; and compensatory mechanisms in the areas. A qualitative assessment was made through running the proposed model in the Banaskantha and Sabarkantha districts of North East Gujarat, which has high human-bear conflict. The data revealed high rate of conflicts in fragmented habitats of northeast Gujarat, where much of the area is not declared as Protected Area. The collected information based on the model explicates several contributory factors responsible for human-bear conflict: lack of a specific management plan in an area, a paucity of research and monitoring efforts, and low level of awareness among the local people. Conflict has eroded the tolerance of people who it has affected. Without any redressal mechanism, the people have turned antiwildlife. Any seemingly harmless animal now attracts large crowds and antipathy. The proposed model therefore addresses the concerns of the people, augments capacity and capability within the government department, and reduces instances of encounters between animal and people, especially mobs in the short term and reduces conflicts by making natural habitats more suitable for bears in the long term. The model would help in collecting and collating basic information about an area that has conflict-related issues.

Can We Ever Live with Brown Bears? Explorations of Human/Bear Coexistence

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Bears are iconic animals. How we relate to them spatially, temporally, and culturally reflects changing social paradigms relating to nature. Brown bears (*Ursus arctos*) are extirpated throughout much of their former range. Human/bear conflict is the main cause of extirpation and population decline. Today, brown bears are largely found in areas free from extensive human modification. As such, bears inherently begin to symbolize wilderness. As the human landscape becomes perceptually less integrated with wildlife, many people are driven to reconnect with these natural elements now absent from their lifescape. Wilderness areas are increasingly attracting tourists, and people are beginning to reconnect with bears in areas that are now valued for their lack of modification. This adds a significant paradigm to our complex and often contradictory relationship with these animals as we seek a very different, indeed benign, encounter with bears. Over 16 years of carefully planned and managed bear viewing in Knight Inlet, British Columbia has created a fragment of landscape in a complex multifaceted ecosphere where spatio-temporal interactions with bears are high, yet there are virtually no recorded cases of negative interactions with the bears. Modifications in the behaviour of the people (even those not involved in tourism) have seemingly created a landscape where humans and bears can coexist. Interestingly, this landscape is highly modified with a man-made spawning channel, logging roads, and cut block forming the frame work for the tourist "wilderness" experience. In the future, human-wildlife conflict reduction in landscapes that are increasingly required to perform on many social and economic levels will be essential. Understanding the dynamic and complex human-bear relationship by exploring the phenomena first hand can offer valuable "local-expert" led insight. Taking results beyond red book publication and peer-reviewed journals is ultimate aim of this research. Using novel (largely visual methods such as participatory video and visual story telling) and interdisciplinary approaches to data collection and dissemination, it remains the aim of this poster to engage conference attendees in the project. Novel display techniques will be employed. Research is still in infancy and presented work is largely based on empirical data collection in 2012.

Evaluating the Efficacy of Intercept Feeding in Reducing Spring Grizzly Bear–Ranching Conflicts

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The propensity for conflict between grizzly bears (a provincially threatened species) and agricultural activities is high in southwestern Alberta. Bear-ranching conflicts are common and are a key management issue both for public safety and to ensure persistence of bears on the landscape. Various ideas exist for reducing bear-ranching conflicts (e.g. attractant management, relocation of offending animals, etc.), but these programs are rarely evaluated. Accomplishing such an evaluation requires the development of cost-effective ways to monitor large carnivore response to management initiatives aimed at reducing conflicts. Using noninvasive methods sampling hairs for DNA analysis, we are evaluating the efficacy of an intercept-feeding program in southwestern Alberta designed to reduce springtime conflicts with grizzly bears. Road-killed ungulate carcasses are slung via helicopter to 13 high-elevation intercept feeding stations during March and April in an attempt to keep bears from travelling to lower elevation private lands where cattle are calving. At each station, WD40 was used to elicit a rub response from visiting grizzly bears, and hair samples were collected to identify species, individual identity, and gender, using nuclear DNA extracted from hair follicles. Our results have been integrated into an ongoing grizzly bear monitoring program using rub objects to monitor changes in grizzly bear populations, densities, and distributions. We will estimate the proportion of grizzly bear population that use the intercept-feeding stations and evaluate differences in distribution patterns between bears that use vs. bears that do not use the intercept-feeding sites. Grizzly bear conflicts will be monitored using the provincial wildlife enforcement database.

Space Use by Urban/Suburban Black Bears in the Mid-Atlantic: A Synoptic Approach

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Spatial ecology of black bears (*Ursus americanus*) in urban and suburban environments is poorly understood. Traditional methods such as compositional analysis, home range analysis, and resource selection functions require each method to be used independently. With a synoptic modeling approach, space use can be modeled using a priori hypotheses and more interesting ecological questions can be considered. We handled 108 bears with GPS/GSM collars in New Jersey, Pennsylvania, and West Virginia during 2010–2012. Due to major collar failure (>50%), we were unable to gather data from all bears for the entire study duration. Synoptic home ranges were smaller and seemed more biologically relevant than traditional estimators. Black bears used forested areas (mostly edge and fragmented forest) and exurban areas (edge of suburbs). Urban bears used areas that were near the forest edge, steep slopes and ridges, and with low population density more than areas with higher density of development, valleys, or agriculture. Over 80% of bears resided on the periphery of urban areas; most bears resided in the suburban/exurban gradient into rural areas. Very few bears (<10%) used agricultural areas. The majority (>90%) of urban bears were residents rather than transients.

Electric Fences for Food Storage in Grizzly Bear Habitat

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The National Outdoor Leadership School (NOLS) developed portable electric fences for food storage in bear habitat. These fences have proven to be practical and reliable when used by untrained backpackers to keep bears out of their food.

The fences were tested in the Greater Yellowstone Area with: known problem black and brown bears by the Wyoming Game & Fish Department in 2002; captive habituated brown bears at the Montana Grizzly and Wolf Discovery Center in 2003–2004; emerging spring brown bears by the USFS Missoula Technology & Development Center (MTDC) in 2003–2005; wild black and brown bears when used by backpackers for 15,000 fence-nights in coordination with the Shoshone National Forest. The USFS published Tech Tip 0723–2305–MTDC "Specifications for Portable Electric Fence Systems as Potential Alternative Methods for Food Storage" in 2007. The U.S. Interagency Grizzly Bear Committee (IGBC) approved these fences for food storage in grizzly bear habitat in 2009. Currently, some public land managers allow use of these electric fences to meet local food storage orders while others don't.

NOLS built 150 fences to the published MTDC specifications and has used them in bear habitat for 50,000 fence nights, with two fence "knock-downs" and no food rewards to bears during this time. 25,000 of these fence nights were in the Greater Yellowstone Area. The presentation will explain some failures during early testing and how they were used to change things like adding marker lights that correlate with high success rates. There was also a shift in development away from an optimally lightweight fence to a fence design that avoided typical human failures. One electric fence kit weighs less than two BRFCs yet can store a pallet of food. The fence can be installed in 3 minutes compared to an hour or two for a good wilderness bear hang. The outfitter model is twice the size and is used by wildland fighters to protect their caches while fighting remote fires in bear habitat, and by horsepackers to store saddles and other tack. The latest designs tested have attempted to deter mesomammals but there are tradeoffs with tighter wire spacing and shorting to vegetation, adding a barrier top use by non-experts.

Electric fences are not an infallible silver bullet, but they work very reliably at deterring bears when used carefully, and they provide a negative reward to probing bears which theoretically supports bear conservation.

Funding for this project came from the National Outdoor Leadership School, the US Forest Service, The Wyoming Game and Fish Department, and the Wyoming Animal Damage Management Board. None of these agencies receive any financial benefits from development of this product.

CONSERVATION AND PUBLIC OUTREACH

Himalayan Brown Bear in Deosai National Park: Current Status and Threats

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The Himalayan brown bear is a critically endangered species in Pakistan. Approximately 150–200 bears may survive in Pakistan in 7 populations. The Deosai National Park (DNP) supports the only stable population. A conservation program targeting brown bears in DNP was initiated in 1994, which continued until 2006. This program helped in the recovery of

the population from 20 in 1993 to 43 bears in 2006. This recovery is significant and provides hope for the survival for the brown bear in Pakistan and in the rest of the species' range in Himalaya. The reproductive potential of this population is the lowest among all documented brown bear populations across the world, which necessitates careful monitoring of the DNP population to ensure its long term survival. Though the park staff is protecting bears from poaching and other threats, there has been no assessment of the population in past 5 years. This study aimed to assess change in the population of bears in past 5 years using multiple methods. We used direct count method, using double observers and single observer, in combination with remote camera trapping to enhance reliability of the results. The direct count method is feasible in DNP, as it is a treeless plateau which allows detecting bears from 2 to 3 km. Brown bears are morphologically distinguishable in Himalaya due to pelage variation and variable white patches, which allowed us to identify them. We also conducted conflict surveys to identify and quantify human-related threats that might have emerged due to growing human and livestock populations.

Direct counts by double observers were analyzed in Huggins Closed Capture model of MARK, and it gave a population size (N) at 44.64 ± 12.6 SE within the park boundary. In addition to this, 11 brown bears were counted by single observer in buffer valleys. Brown bear were also captured at 9 out of 116 camera stations set up during the study. A total of 11 animals were captured, including 5 males, 3 females, 2 cubs and 1 of undetermined sex because it did not come fully in front of the camera. It is recommended to do annual census by using double observer protocol by park staff to monitor the population of brown bear.

Public interviews indicate a higher sighting rate for brown bear (5.2 per respondent) as compared to other predators like wolf (2.4), snow leopard (0.3) and lynx (0.3). Depredation cases of brown bear (15%) were lower than wolf (61%) and snow leopard (22%) but higher than lynx (2%). Livestock, being the major threat to bears and their habitat, are reported to be about 14,000 in total.

Status of Black Bear Population in Pakistan

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We conducted questionnaire-based structured interviews (n = 3700) of randomly selected notables, hunters, and wildlife lovers residing in different potential bear tracts after obtaining their verbal consent to participate in the study during 2008–2009. Organization of the information extracted through responses from the interviewees for different broad localities, we developed population biology variables of black bear in different parts. Based upon preliminary information, we believe that the Baluchistan black bear is still present as small populations in different isolated tracts of southwestern Pakistan. Yet due to political instability and unresponsive attitude, we could not extract much information on numbers, exact location and population compositions of Baluchistan black bears. On the basis of information given by respondents to the questionnaire study from northern parts of Pakistan, Azad Jammu and Kashmir, we propose that a population of about 950 black bears is present in Pakistan: the province of Gilgit-Baltistan supporting 173 heads (major population in Astor, 124), Khyber Pukhtoonkhwa (KPK) supporting 745 heads (major population in Mansehra (480), and Azad Jammu and Kashmir. We propose a normal 1:1 male:female sex ratio (1.12 male/female), indicating a normal distribution among the sexes. Sex ratios were awkward where the population size was small. We estimated cub/ female ratio of 0.91 for total population, ranging between 0.0 (Gilgit population comprising of 2 males and 1 female) and 1.15. We suggest that this is still a good breeding population. We do not have a data on natural mortality. With the data in hand, we suggest extraction of 8–10 cubs and an equal number of adults females killed during cub-trapping, under the recent conservation measures adopted by wildlife departments and check on the dog-bear fights. We believe that present population can amicably sustain this mortality. We could not collect data on isolations existing between subpopulations and extent of man-bear conflict. We recommend detailed population studies to support the present conclusions and to base the future conservation on sound footings.

Curbing Bear Baiting in Pakistan: Status Update of a Multipronged Approach

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Bear baiting has been practiced in Pakistan for over 100 years and was conducted publically during local public fairs under the umbrella of, and to fetch honour for, local influential landlords. Himalayan brown bears (*Ursus arctos isabellinus*) and Asiatic black bears (*Ursus thibetanus*), poached from the wild, are kept by gypsies in poor hygienic and malnorished conditions and are hired out for such events. Unconfirmed estimates claim that during the 1990s around 1000 bear-baiting events were held in the country where around 1000 bears were baited each year. Loss of individual bears due to injury during bear baiting or due to natural mortality was replanished with new recruites coming from wild, resulting in decline of wild bear population. We planned and executed a multi-pronged comprehenssive strategy for controlling the menace of bear baiting, which included (a) mobilization of religious leaders, (b) engaging over 9000 mosques leaders, (c) monitoring public fairs and assisting local authorities in preventing the holding of bear baiting events, (d) developing interaction with influential and powerful landlords, (e) influencing landlords through both political and spiritual networks, (f) providing alternate livelihoods to bear owners for surrendering their bear, (g) reducing the crowd and thence the honour of the bair baiting events through attracting public at fairs towards alternate entertainment, and (h) developing a sanctuary to provide a safe home for surrendered/confiscated bears. All these activities were GIS guided, which allowed best possible use of resources. Through our efforts the number of bear-baiting events was brought down to 116 in 2008, when 49.6% of the monitored public fairs hosted bear baiting events. With persistance of this strategy, in 2012 only 3.4% of the monitored public fairs hosted bear baiting events, and only 35 such events were registered, the majority being organized secretly by the landlords.

Comanagement and Polar Bear Conservation in the Inuvialuit Settlement Region of Canada's Western Arctic

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The Inuvialuit Settlement Region (ISR), in the northwest corner of Canada, is the only area in the Northwest Territories with resident polar bears. This region was established by the signing of the Inuvialuit Final Agreement (IFA) and The Western Arctic (Inuvialuit) Claims Settlement Act in 1984. Pursuant to the agreement, co-operative management structures were established, including the Wildlife Management Advisory Council (NWT), with the mandate of providing advice on issues pertaining to wildlife in the ISR. This includes polar bears. Working under a comanagement system means developing partnerships and working together to come to solutions that are mutually agreed to and implemented collaboratively with the local hunters and hunters committees. Polar bear management in the ISR is a success story with local commitment to the management system and strong hunter participation in sample submission and data collection. The presentation will describe the comanagement system under the IFA and describe how polar bear harvest is managed under that system.

Bears and Place Making in British Columbia

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Extreme sports, adventure, and ecotourism are bringing increasing numbers of people into remote backcountry areas worldwide. The number of people visiting wilderness areas is set to increase further. Nature tourism is the fastest growing sector in the $3.5 trillion global annual tourism market (Mehmetoglu 2006). What impacts will this have on the social perceptions and economic and conservation values of these areas and the species which are found there? Reflecting on over a decade's research on the impacts of the bear-viewing ecotourism industry in British Columbia, Canada, this paper considers place and "place making" via a case study of bear tourism in British Colombia (BC), Canada.

Do Sloth Bears Inhabit Bhutan? Did They Ever?

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Sloth bears (*Melursus ursinis*) are restricted to primarily lowland habitats on the Indian subcontinent. Their historical distribution included only 5 countries: India, Sri Lanka, Nepal, Bhutan, and Bangladesh. In the northern and eastern portions of this range they overlap, and are often confused with similar-looking Asiatic black bears (*Ursus thibetanus*). Sloth bears are more specialized in food habits than black bears and therefore are more vulnerable to habitat alterations; they are also more aggressive and thus feared (and killed) by people. Sloth bears disappeared from Bangladesh, apparently due to habitat loss and poaching, sometime in the past 20 years; this was not noticed until a formal survey was undertaken, and it became evident that reports of extant sloth bears were actually black bears. A lack of documented evidence of sloth bears in Bhutan prompted us to investigate their occurrence in this country. Bhutan is a highly mountainous country, and potential sloth bear habitat occurs only along a very narrow strip of lowlands bordering India. In December 2012, we surveyed a principal part of this area within Royal Manas National Park, looking for distinctive sloth bear sign (diggings in termite mounds). Although we found bear sign (claw marks on trees), we surmised that it was all from black bears. We also examined numerous camera-trap photos taken as part of an extensive effort to monitor tigers (2009–2012). We identified only 1 sloth bear (at a salt lick near the Indian border) among many photos of black bears. On the Indian side of the border, however, in adjoining Manas NP, sloth bear sign, photos, and reports were more common. We conclude that sloth bears are rare in Bhutan; some individuals may occasionally come across the border from India, but a self-sustaining population may not exist. We discuss potential reasons for this, and look back at historical records to put the current situation into context.

Conserving Habitats: Importance of Outside Protected Areas for Sloth Bear Conservation in Odisha, Eastern India

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Conservation of threatened large vertebrates in fragmented landscapes has become a central issue for conservation biologists. In India it has become increasingly significant as human populations expand and encroach on sloth bear habitat. Although not a new problem, its apparent increase threatens conservation efforts of sloth bears. Here, we evaluated the geographic distribution of sloth bears in Odisha by GIS technologies, in relation to the habitat quality and importance of outside protected areas. We used a grid-based sampling approach in the study area (land use and land cover map; scale 1:50,000). The landscape characteristics were analyzed and determined the most important landscape level factors for sloth bears. The information on presence/absence of sloth bears were collected from previous studies, interviews with local people, knowledgeable wildlife experts based on their field observations, and our own field surveys. Sloth bears occupied 65% of the study area with approximately 70% contained within nonprotected areas where people and sloth bear shared their resources. Our key management recommendations for sloth bears in the region is the need to expand the current management plan beyond the protected areas to encompass the entire land base of sloth bear occupied areas.

Sloth Bear Conservation in Sanapur Reserve Forest, Karnataka, India

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Sloth bears still occur in isolated forest patches throughout India. Sanapur Reserve Forest is an isolated forest patch in the state of Karnataka that is still home to sloth bears as well as several other rare species. Wildlife SOS has been working in this area to conserve sloth bears by several different means including (1) buying land, (2) hiring forest guards, (3) planting trees, (4) building wetland areas, (5) running educational programs, (6) conducting sloth bear surveys, and (7) monitoring human-sloth bear conflicts. In 2006 when Wildlife SOS initiated habitat conservation, nobody had a holistic idea of the impact of the activity. Initially, 6 local guards were appointed to patrol the entire bear habitat. The rocky boulders with scrub jungle spread on undulating hill ranges provide shelter and food for the bears. In the plain land, between the hill ranges there are farmlands, where the tribal farmers grow rain fed crops. The entire habitat was under much exploitation by surrounding villagers from quarrying, wood cutting, and hunting. Forest fires were also becoming more common and turned the excellent bear habitat to a degraded jungle. Man-bear conflicts were also common and on the rise. The underground water table was depleted, and the tube wells became dry. Wildlife SOS surveyed the habitat and appointed local people as guards. They were assigned the task of patrolling the entire habitat comprising about 40 km2 to prevent forest fires, stone quarries, hunting, wood cutting and encroachment. Although villagers initially resisted these changes, they gradually got accustomed to the habitat protection and stopped wood cutting, hunting, and quarrying. Apart from this, Wildlife SOS conducted awareness programs in the schools of surrounding villages, screened films on wildlife, and interacted with the village leaders and hunters. After successful conservation measures for more than 6 years, today the entire valley has become lush. Trees sprout from the old stumps and bear various fruits seasonally which the bears feed upon. The underground water table has increased and farmers are growing 2 crops a year. Water now flows in the "permanently" dried streams for more than 9 months of the year. All the villagers around the habitat are happy for the repletion of their ground water table. Man-animal conflict has also been reduced drastically.

Connecting with the Public to Promote Bear Awareness and Conservation: The Conservation Education Committee Refines Its Role

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In 2011, the International Association for Bear Research and Management (IBA) established a Conservation Education Committee (CEC) to further objectives 5 and 12 of the IBA mission statement, enhancing bear-focused education of the general public. The CEC seeks to (1) increase public awareness and understanding of bear ecology, conservation, and management by encouraging the translation of technical information into popular literature and other media, and (2) aid in connecting human communities to bear conservation efforts in an effort to mitigate conflicts between people and bears. Utilizing popular media and other web resources, the CEC will highlight science-based research and on-the-ground conservation efforts being conducted by IBA members, and connect these efforts to laypeople worldwide. It will aid in development and promotion of science-based education that will focus on translating scientific research and other technical information into bear-based conservation modules for both students and teachers. We will promote bear awareness programs and other events that highlight these charismatic species. Finally, the CEC will develop templates of printed outreach materials, web media, and interpretive exhibit signage that convey current and accurate data on bear species in the context of threats they face. Each of these efforts will also highlight the opportunity for the public to contribute to bear conservation and research efforts via the Bear Conservation Fund. Ultimately, the CEC will play a role in improving the state of knowledge of bears and their needs among the people upon whom their conservation status is most dependent.

Bear Conservation Starts at Home: One Organization's Approach to Sun Bear Conservation through Palm Oil Awareness

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The IUCN describes habitat loss as one of the 2 most significant threats to the sun bear (Helarctos malayanus). It further describes palm oil as a major driver of habitat loss. Forest conversion for development of oil palm plantations has accelerated in tropical southeast Asia where sun bears are found; indeed, predictions suggest that three-quarters of the original forests of this region will be gone by 2100. As biodiversity in the area declines, sun bears and other well-known species like orangutan, pygmy elephant, Sumatran rhinoceros, and others face threats of extirpation and, in some cases, extinction. Environmental NGOs have tried various approaches to address the palm oil crisis, from advocating the use of no palm oil, to promoting the use of sustainable palm oil where feasible. San Diego Zoo Global (SDZG), a not-for-profit organization that includes 2 wildlife parks and a conservation research center, has taken the latter approach, joining the Roundtable on Sustainable Palm Oil (RSPO). In surveying its employees, SDZG determined that most were unaware of the role of the RSPO; thus a 2-part awareness program was instituted in which both staff and patrons could become better informed about this manner of addressing the palm oil crisis. Ultimately, SDZG is poised to provide a significant voice on this issue to the people of North America, who increasingly play a role in driving this conservation threat to sun bears.

The Effects of a Guided Tour Program on Public Awareness of Asiatic Black Bear Restoration Project

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Asiatic black bear restoration project is the first of its kind for large mammals of Korea. In order to ensure a successful restoration project, various activities are called for in many different areas including research study, outreach programs, habitat management, and public relations, to name just a few. Notably, a guided tour program has been in operation since 2006 in order to form a consensus on a bear restoration campaign and to build partnerships by way of promoting the project's significance and importance. This study attempts to analyse the types of visits made by visitors to the restoration institute by classifying them on a monthly basis and on regional distribution. Also, the number of visitors were analysed annually from 2007 to 2012. Comparative analysis of the level of public awareness was made from surveys taken during the earlier phase of the bear restoration project in 2006, with that taken in 2012, which was conducted among the general public and local residents. Two types of guided tour programs had been developed: "Come and meet our friend the moon bear," and "Wild animals in the eco exhibition" to stand in for the hibernation period. These programs catered to the general public with total number of participants reaching 19,945 in 2012 after 761 tours. As for monthly participation rates, the total number of visitors during the months of December to March were determined at 1433 when the bears would go into hibernation. Participation rate during these months registered a poor showing at 7.2% in comparison with the total number of visitors reaching 19,945. However, when spring arrived, which signaled the tailend of the hibernation period, number of visitors tended to rise steadily. Annual participation rate reached 7729 visitors in 2007, 7715 in 2008, 7979 in 2009, 13,942 in 2010, 15,859 in 2011, and 19,945 in 2012. Compared to the inception of the guided tour program in 2007, rate of increase reached 258% in 2012. Variation in rates of awareness regarding bear restoration project reported as having 49.6% of the targeted general public (N = 1000) answering aware and 50.4% replying unaware in 2006 while in 2012 those who answered aware rose 73.3% and unaware lowered to 26% resulting in 23.7% in variation factor. In the case of local residents (N = 500), 62.4% replied aware and 37.6% unaware in 2006. However, in 2012, 77.8% were aware and 22.2% were unaware, leaving 15.4% in variation factor. Improvement in awareness of the bear restoration project is the result of various publicity campaigns. Among them was the guided tour program initiated in 2006, which helped to bring about change in perspective in the general public and in those who live adjacent to Jirisan Mountain.

Conservation Biology Sloth Bears of Odisha State, India

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In order to create protected sloth bear conservation in Odisha State, community participation suggested to avoid human bear conflict. To resolve this conflict, the basic issue of a deteriorating habitat, improvements through government- or community-based reforestation programs may be promoted. Bears in Kenghar district are seriously threatened due to habitat loss and are sometimes captured for performances and for their bile. The sloth bear, also known as the stickney bear species, is found wild within the Indian subcontinent. The state of Odisha is located on the east coast of the Indian Peninsula and occupies a total area of 155,707 km^2. The climate of Odisha, an area that hugs the coast of the Bay of Bengal, is represented by tropical monsoon weather. Searing hot summers with considerably high monsoon downpours and cool and pleasant winters mark the Odisha climate. Sloth bears do not hibernate. They make their own rest in broken branches of trees and will rest in the hollows of trees and will rest in caves during rainy season. They breed during spring and early summer. They give birth to 1–2 cubs, and sows gestate for about 7 months and typically give birth in caves or in shelter under boulders. Their psychology, behaviour, ecology, reproduction is the most researched part of their lives. During this period, they do not tolerate any human interference. The species is most vociferous when mating and individuals make loud melodious calls when doing so.

Sloth Bear of India: Conservation and Management Strategies

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In India, 4 species of bears are found: the sloth bear (*Melursus ursinus*), the Asiatic black bear (*Ursus thibetanus*), the sun bear (*Helarctos malayanus*) and the Himalayan brown bear (*Ursus arctos*). Moreover, some zoos also hold the European brown bear (*Ursus arctos arctos*), whereas the number of other species has remained stable except the sloth bear which has shown an increase after the year 2004–2005. This period coincides with a drive to stop the tradition of bear dancing in India by various NGOs like the Wildlife SOS and Wildlife Trust of India. Consequently, a number of sloth bear were rescued from Kalanders and moved to zoos and rescue centers. The sloth bear is the most widely, but patchily, distributed bear species in India, ranging from the foothills of the Himalaya and Terai grasslands in the north to the southern Western Ghats of India. In India, 90% of sloth bear populations are confined to the dry and moist deciduous forests of which the former account for 50% of the sloth bear populations. The potential of sloth bear distribution range in India was estimated to carrying capacity of 200,000 km2. There are 70 zoos and 5 rescue centers that are housing a total number of 795 individual bears, out of which 562 are sloth bears (male–292; female–267, and unknown sex–3) in captivity for the purpose of conservation, education to the public, and for their lifetime care. Bears have been poached for gall bladder and other parts, which are often exported to southeast Asian countries as an ingredient to traditional Chinese medicines. The sloth bear is listed in Schedule I of the Indian Wild Life (Protection) Act, vulnerable in Assam. Special powers accorded to the forest staff in Assam have enabled them to patrol the protected areas more effectively than other parts of the country. It is also listed on Appendix I of CITES and on schedule II of the Indian Wildlife (Protection) Act as amended in 2003. The Forest Conservation Act (1980) and the National Wildlife Action Plan (1983) afford protection to the habitats of this species. Creation of a network of protected areas has afforded protection to sloth bear habitats in Sikkim. There are many positives in resorting to the option of 'return to the wild' of bear cubs with rehab potential as opposed to the option of depositing the cubs for lifetime care in zoos and rescue centers. Orphan bear rehabilitation brings down the number of animals in facilities, which are already overcrowded, takes care of welfare of individual bears, which is otherwise compromised in captive facilities, and more importantly contributes to conservation in areas where supplementation or reintroduction is required. All these rehabilitation programs, if properly communicated to local community, can also act as ambassadors of conservation, spreading awareness on the plight of orphans and the causes leading to their displacement from the wild.

Status and Distribution of Himalayan Brown Bears in District Chamba, Himachal Pradesh, India

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The status and distribution of Himalayan brown bears (*Ursus arctos isabellinus*) was studied in Chamba district (area 6528 km^2) including 5 wildlife sanctuaries and Pir-Panjal and Dhauldhar range falling in chamba district from 2007–2012 (140 days in 6 years). The information was gathered through field surveys, direct sighting, videography, informal interviews with nomadic shepherds, and from primary and secondary data. The line transects were placed (22 in Kugti, 16 in Tundah, 12 in Khaziyar Kalatop, 12 in Gamgul Sihabehi, 9 in Sachutaun Nalla wildlife sanctuaries, and a total of 180 km of survey walks were carried out along the rugged mountainous Pir-Panjal and Dhauladhar range. Line transects were 4–6 km long. Type of signs included direct sighting, (GPS Locations), scats, digging signs and damage to crops. Brown bear presence was confirmed in 4 wildlife sanctuaries, and the highest density and encounter rate was reported from Chadola Dhar (Tundah Wildlife Sanctuary) where 9 adult individuals were sighted in a single day. Fragmented population of brown bears along the Pir-Panjal range were documented and 7 potential habitats were also identified outside protected areas in the district.

In Chamba district, out of 5 wildlife sanctuaries, Kugti and Tundah are the only sanctuaries where fragmented population of brown bears has been identified and confirmed. The sizes of their population do not exceed 18 in Kugti, and 12 in Tundah wildlife sanctuary, and 30 along the Pir-Panjal and Dhauldhar range. The study also reveals the bear's presence in Pangi valley. Increasing number of livestock, especially sheep and goat, and increasing dependency on natural resources, particularly subalpine and alpine pastures, are key threats. Actions like effective management of fragmented potential habitats need special attention.

Bridging the Gap Between Scientific Research and Education Outreach

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Bear Trust International (BTI) and Alaska Wildlife Conservation Center (AWCC) are bridging the gap between scientific research and education outreach with 4 programs: (1) data-rich conservation lessons rooted in real-world bear research, (2) live interactive distance learning opportunities that link bear scientists with classrooms, (3) research portals that connect visitors with 8 different field studies that represent the 8 species of bears, and, (4) education messaging based on ecology, bear research, and human dimensions research. For our data-rich conservation lessons, we are partnering with field scientists worldwide who share data with us. We translate these real-world data into engaging, timely, and conservation lessons (free for youth and educators) that incorporate wildlife science technology (e.g., GIS, GPS, Program MARK) and meet National Science Standards and STEM (Science, Technology, Engineering, and Math) goals. Our distance learning lecture series, "Bears of the World," connects real-world bear scientists with youth around the country. Our research portals highlight current fieldwork on wild bears, connecting the public with on-the-ground conservation research. All 8 portals will be housed at the upcoming BEARS (Bears Education Awareness Research Sanctuary) at AWCC. Finally, in efforts to ensure that the AWCC education messaging about the 8 species of bears resonates with the public, our education panels include findings from both bear research and onsite human dimensions research.

Study on Sloth Bear Occupancy in South Central Gujarat, India, to Suggest Possible Corridors for Sloth Bear Habitat Management

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The sloth bear (*Melursus ursinus*) is the most widely distributed species of bear in the Indian subcontinent and is distributed in variety of habitat such as Teak forest and Sal forest, lowland evergreen forest, and the hill country up to elevation of 1700 m. Sloth bears are also found in riparian forests and tall grass areas on the floodplains of Nepal and in the Bhrahmaputra valley of Assam. Presently sloth bears occur commonly and are distributed widely across the tropical forest of the Indian subcontinent. Gujarat is one of the states in India where the highest density of sloth bear is recorded. The National Bear Conservation and Welfare Action Plan 2012 reported the sloth bear habitat range in Gujarat is 3791.39 km2 out of which around 1200 km2 area falls under the central and south part of the state. Sloth bears are occurring mainly in the northeastern part to the southern part of Gujarat State which is adjoining to Rajasthan, Maharashtra and Madhya Pradesh states. Earlier studies in the northeastern part of the state have revealed the patchy and fragmented distribution of the sloth bear. The present study has been carried out in the southern and central part of the state which has never been studied for sloth bear distribution and where very little is known about the present status of their population. We studied the sloth bear occupancy in the study area using the sign survey method by dividing the entire study area into the grids of 5 km^2. Each grid overlaid on a 1:50000 toposheet was surveyed for bear presence and absence. Study also focused on identified corridors between the forest patches and whether they are used by sloth bear. The sign of sloth bear like pugmarks, scat, claw marks on the tree, open termite mounds, etc., were considered for presence of bear in the area. The data were analyzed by the

software Presence®. The study reveals that the sloth bears in the area are more occurring in the unprotected forests which are close to human habitation. Moreover we identified some important corridors between the protected forests which can be altered and managed for the movement of sloth bear and other wildlife.

Creating Connections: Engaging Citizens Through Training to Identify Andean Bears while Promoting *in situ* Involvement

Corrin LaCombe, Russ Van Horn, Becky Zug, and James Danoff-Burg

As conservation efforts increasingly rely on developing local collaborators and seek to maximize return on conservation efforts, we must create innovative opportunities to capitalize on interdisciplinary expertise and develop sustainable practices. Here, we share an example of how we were able to involve local participants who visited the San Diego Zoo Institute for Conservation Research in a learning module experiment that answered a field-inspired research question: 'Can humans reliably identify individual Andean Bears using photographs?' Results of this study are augmenting in-situ conservation research on Andean Bears in South America by increasing validity of data collected by local para-ecologists, while also ensuring their continued involvement in the project by enabling them to train others in this skill. This study is an example of how to creatively enhance the skills and engagement of local collaborators while generating awareness, collecting rigorous data, and efficiently addressing conservation challenges utilizing various disciplines and outlets.

Research Findings from a Public Opinion Survey on Asiatic Black Bear Restoration Project

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This study was conducted to apply to future restoration of endangered species including bear and to confirm how public opinion (knowledge and level of awareness) was changing.

Survey targets included general public (1000 people), experts (50 people: scientists, NGOs officers, etc.), and local residents (500 people) living in 5 counties adjacent Jirisan National Park where Asiatic black bear restoration project has currently been taking place. And it was done twice in 2006 and 2012. They were surveyed on level of awareness (2 questions), interest (2 questions), priority (2 questions), necessity (2 questions), and leverage (1 questions) concerning Asiatic black bear restoration project. Survey method used was primarily one-on-one telephone survey along with e-mail survey directed at experts. Survey results were analyzed with 3 target groups divided according to their age, academic background, income, occupation, and region by descriptive statistics using the SPSS 10.0.

The result of the public opinion survey on restoration project in general showed increase of favorable responses in all 3 target groups. Specifically, general public showed increase of 2.87% (69.31% in 2006 to 72.18% in 2012), and experts showed a 0.54% increase (90.96% in 2006 to 91.50% in 2012) while local residents showed a 14.5% increase (58.11% in 2006 to 72.61% in 2012) which far exceeded the other 2 groups in positive feedback.

Notably, local residents' opinion on continuation of the Asiatic black bear restoration project category were relatively low (56.77%) on the survey taken in 2006. However, 2012 survey reported 76.23%, a substantial increase (19.46%) in favorable responses. Those favorable responses will be helpful to restore not only Asiatic black bear but also other endangered species in Korea.

The Andean Bear Conservation Alliance—Collaboration is Key

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Andean bears are an important flagship for the unique and fragile Tropical Andes ecosystem, the richest and most biologically diverse region on earth. Currently listed as vulnerable, the species faces a number of threats including habitat reduction and fragmentation, human induced mortality, insufficient scientific knowledge on distribution, threats and trends in bear populations, and often a lack of institutional capacity and resources to manage protected areas and wildlife populations.

In order to design effective conservation plans for Andean bears, updated and accurate information on the species distribution, abundance and conservation status is needed. This important information is still lacking for many parts of the Andean bear range.

A group of dedicated institutions, with clear goals and well developed tools, can help to address these issues by consolidating efforts around a common action plan for Andean bear conservation. The Andean Bear Conservation Alliance (ABCA) is a partnership initiative of the Wildlife Conservation Society, Cleveland Metroparks Zoo, and St. Louis Zoo, in collaboration with the IUCN Bear Specialist Group and other partners. The aim is to provide direction, focus and support to key Andean bear conservation efforts around a central goal.

The focus of the first ABCA Five Year Action Plan is to build the tools and human capacity needed to produce an accurate and updated assessment of the distribution and status of the remaining Andean bear population. This will be achieved through targeted research, exploration and capacity-building projects done in collaboration with governmental and non-governmental organizations in Andean bear range countries.

The Andean Bear Conservation Alliance has already developed and tested the monitoring tools and techniques needed, initiated valuable ecological studies and explorations, and is creating the capacity-building opportunities that will make the work possible. This multifaceted approach will be central to achieving the goals of the ABCA Five Year Action Plan.

Session 18
BEHAVIOR

Infanticide in a Scandinavian Brown Bear Population: Causes and Consequences

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Causes and consequences of infanticide are intensely debated within the scientific community, partly because it is extremely difficult to document infanticide in the wild. Here, we summarize findings of an intensive field study (2009–2011) on causes and consequences of infanticide in a Scandinavian brown bear (*Ursus arctos*) population. We recorded fine-scaled encounters between GPS-collared females with cubs-of-the-year (hereafter 'females/cubs') and other reproductive classes of bears, as well as sudden changes in their movements. We used tracking dogs to investigate encounter sites for cases of infanticide. We found that ~35% of the cubs died annually because of infanticide, which occurred exclusively during the mating season. All known perpetrators were males. Spatial and genetic data showed that perpetrators did not kill their own offspring. Behavioral and endocrinological data suggested that females enter estrous already 1–2 days after litter loss. Most females (92%) that lost their litter gave birth the subsequent birthing season. The perpetrating males always consorted with the victimized mothers and had a high probability to father her subsequent litter. Based on resource selection functions (90 bear-years, ~500,000 GPS locations), we showed that females/cubs segregated from conspecifics during the mating season. Other than conspecifics, females/cubs then selected for less dense vegetation, less rugged landscapes, and for areas close (<1500 m) to human settlements. After the mating season, females/cubs selected their resources similar to conspecifics and strongly avoided humans. Based on diet quality data (491 fecal samples), we showed that avoiding conspecifics in space and time comes with a nutritive cost. Our results strongly indicate that infanticide functions as a male reproductive strategy in our study area. We found little or no support for alternative explanations, such as infanticide as a foraging strategy, as a strategy to reduce future competition, or explanations related to sexual size dimorphism.

Food Availability Affects the Scent-Marking Frequencies of Wild Brown Bears

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For many species, chemical signalling is used to signal the competitive ability of individuals and therefore plays an important role in the breeding system. As breeding generally promotes intrasexual competition, the potential fitness costs associated with competitive behavior may be mitigated if individuals are able to assess their own ability, and the competitive ability of others, prior to agonistic encounters. Due to their hierarchical social structure and large home-range size, bears (*Ursidae*) are thought to rely highly on olfactory methods of communication. Through camera traps orientated towards bear

'rub trees' over a 3-year period, we have begun to establish the function of strategic tree selectivity and the social function of marking behaviour for brown bears (*Ursus arctos*) in the Glendale drainage, British Columbia. We hypothesised that marking trees function to signal competitive ability between individuals, with dominant individuals signalling their high competitive ability and receivers detecting these cues and modifying their behaviour accordingly. Here, we provide evidence to further these hypotheses by demonstrating how scent marking frequencies vary in relation to food availability.

Scent marking frequencies were analysed during the pink salmon Oncorhynchus gorbuscha run (August–October) of 2010 and 2011. Pink salmon stock monitoring by Fisheries & Oceans Canada provide a count of individuals entering the Glendale river system and spawning channel. As the diet of brown bears in the study area has previously been reported to comprise 82% marine meat, pink salmon return data provides a rare insight into food availability during hyperphagia. Moreover, 2010 was considered as a year of "low" pink salmon return and 2011 a year of "high" pink salmon return, providing a method of assessing scent marking behaviour in years of varying levels of competition.

Evidence was found to support the prediction that adult males would mark significantly more in years of low food availability (high competition). We also found evidence to suggest that adult males investigate marking trees more in years of lower food availability (high competition). Knowledge of the dominance of other individuals may be retained across seasons and affect social behaviour in the following breeding season. Adult females displayed an interesting change in behaviour between 2010 and 2011, by marking and investigating trees more in the year of higher food availability (low competition). They were more likely to engage with a marking tree by marking or investigating it when passing in 2011 than 2010. In plentiful years adult females may have more time and energy to display dominance for the following breeding season. As adult males reduce their frequency of investigation in such years, female scent marks may be signals to other females. The trend of marking and investigating trees did not change significantly for females with young or subadults between years of varying food availability/competition; they were associated with marking and investigating trees as expected from their frequency on trails containing marking trees. This study is the first to examine the plasticity of scent marking behaviour in relation to food availability in an ursid species.

Estimating Grizzly Bear Use of Large Ungulate Carcasses with GPS Telemetry Data

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Ungulate meat is among the most calorie-rich food sources available to grizzly bears (*Ursus arctos*) in the greater Yellowstone ecosystem. However, the ephemeral and unpredictable nature of carcasses makes them difficult to study and their influence on grizzly bear foraging and spatial ecology is poorly understood. Whereas several techniques exist to detect kill or carcass sites for obligate carnivores, the omnivorous foraging habits and social hierarchy of grizzly bears make these approaches less robust. We developed a spatial-clustering technique specifically for detecting grizzly bear use of large ungulate carcasses using Global Positioning System (GPS) telemetry locations (n = 54 bear years). We developed an algorithm to identify GPS clusters based on a set of 18 space-time covariates derived from the GPS locations. We then intersected the GPS clusters of individual bears (n = 2,038) with an independent dataset of site visits to recent bear movement paths based on randomly selected, 24-hour blocks GPS locations (n = 732; 2004–2011), resulting in 174 clusters associated with known bear behaviors (e.g., resting, travel, carcass use, digging). We condensed the suite of behaviors associated with clusters into a categorical variable with 5 discrete classes (resting, multiple-use, low-biomass carcass, high-biomass carcass, old carcass). Using a large suite of predictor variables derived from GPS telemetry locations (e.g., duration of cluster, area used, activity sensor values, re-visitation rate), we used multinomial logistic regression to predict the probability of belonging to each of the 5 response classes. We tested a suite of models and assessed model performance based of the proportion of clusters correctly classified. We focused our results on the high-biomass carcass category, for which our top model correctly classified 88% of the carcasses identified as large ungulates during site visitations.

Examination of prediction errors showed that all Type I (high-biomass carcass incorrectly assigned to another category) and Type II (categories incorrectly classified as high-biomass) errors associated with classification of high-biomass carcasses were from the low-biomass or old carcass categories (i.e., not resting or multiple-use). Most Type I errors for high-biomass carcasses were associated with the presence of multiple bears or wolves (*Canis lupus*), which likely resulted in the reduction of accessible biomass for collared bears generating the clusters. Alternatively, most Type II error in this class were associated with mule deer (*Odocoileus hemionus*) carcasses that were classified in the field as low-biomass, suggesting they may be more appropriately classified as high biomass carcasses. We discuss the roles of over-fitting and cross-validation for estimation of large-biomass carcasses. We provide several case studies to demonstrate how this technique may be applied to broader questions regarding bear foraging behavior and space use dynamics.

Grizzly Bear Behaviour in Forested and Harvested Stands in the Working Forest of Sub-Boreal British Columbia

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Forestry operations impact the distribution, abundance, and diversity of species as well as the processes of succession. For grizzly bears (*Ursus arctos* L.) there are 3 potential adverse effects: the removal of canopy cover may result in a reduction of security cover; the creation of monocultures and/or even age stands that may regenerate with little forage for bears; and, the creation of roads may lead to increased human caused mortality. Conversely, logging may increase early bear forage production by promoting the growth of early seral species. We visited 311 locations of 28 (16 female, 12 male) grizzly bears, 1998–2003, to determine how bears were using the landcover type in which they were located. We placed the primary stand type bears were located into 3 categories: (1) cutblocks which included locations along forestry roads, partial cut areas, and pipelines/power-lines adjacent to cutblocks; (2) forested stands composed of either deciduous or coniferous trees; and, (3) other nonforested, vegetated habitats such as meadows, cleared farmlands and wetlands. Bear sites were normally visited within 7 days of the relocation and the primary activity was classified as foraging, travelling/moving, mortality of the study bear, resting, rubbing on trees, and other or undetermined. We further delineated the foraging category into primary forage types: ants, berries, carcass or meat, cambium, digging for roots or rodents, grazing vegetation, or non-natural anthropogenic attractants. Bears used cutblocks differently than forested stands and other non-forested landcover types. Of the forage items, grazing on grasses and forbs and digging for the roots of vegetation was common in all three stand types. Bears fed on more ants/larvae in cutblocks than forested stands, whereas they fed on more meat in forested stands than cutblocks. We did not detect bears foraging more on berries in cutblocks than forested stands. Twenty percent of the behaviours recorded related to non-foraging activities (7% were undetermined). Resting was the primary non-foraging related behaviour with bears resting more in forests than cutblocks. Moving/travelling was similar in forested stands and cutblocks but occurred more in other non-forested habitats. We also examined activities by spring, summer, and fall seasons; however, bears tended to have distinct uses for the different landcover types making seasonal comparison difficult due to a small sample size in one of the landcover types. For example, bears rested so infrequently in cutblocks as compared with the forest we could not perform significance tests. Bear activities varied by landcover type and season; bears tended to feed in cutblocks and rest in the forest.

Assessing the Scent-Marking Behaviour of Wild Brown Bears: An Exploration of Time and Energy Investment, Marking Motor Patterns and Age-Related Development

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Members of the order Carnivora employ a wide range of postures and stereotyped patterns to mark their scent onto objects and thereby communicate with conspecifics. Despite much anecdotal evidence on the marking behaviour of ursids, empirical evidence of scent marking motor patterns displayed by wild populations is lacking. Analysing the time bears spend at marking trees and the behaviours involved, could provide further insight into the function of marking and highlight time and energy investment. Over a 3-year period, camera traps stationed at marking trees were used to investigate scent marking and investigatory behaviour by wild brown bears (*Ursus arctos*) in coastal British Columbia. This work follows on from data presented at the 18th, 19th & 20th IBA conferences.

Evidence was found to support the prediction that males would invest more time and energy in marking than other age/sex classes, which suggests they gain higher net fitness benefits from chemical signalling. As time and energy investment at marking trees did not appear to vary between seasons for any age/sex class, chemical signalling may contribute to individual fitness throughout the whole non-denning period. Transitions between marking postures were assessed using Markov chain analysis. Scent marking patterns varied by age and sex; adult males exhibited a stereotyped pattern of marking behaviour which included some postures which were continually used more often than others, termed here 'core' and 'secondary' marking postures. The marking behaviour of adult females was less repetitive than adult males and displayed core marking postures only. The behaviour of subadults (sexes combined) was a variation and simplification of the patterns displayed by adult males and females. The wider variety of marking postures selected by adult males may function to convey a more complex chemical signal. The behaviour of cubs depended on their age and the behaviour of their mother. Younger cubs were more likely to conduct the same behaviour as their mother, whereas older cubs exhibited behaviours independently. Scent marking in brown bear cubs may function in learning or safety.

This study is the first to assess the time invested in marking and receiving scents, and to present empirical data on stereotyped marking behaviour in wild ursids. This study also presents the first assessment of the behaviour of young at marking trees in any member of the Ursidae, and evidence on the development of marking behaviour in young bears.

Activity Budgets of Japanese Black Bears Fluctuate not only Seasonally, but also Daily

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Although activity time budgets of the Ursidae are known to vary according to numerous factors, there is little published information on activity time budgets of the Japanese black bear (*Ursus thibetanus japonicus*). We studied the fluctuation of daily time budgets in Japanese black bears throughout the year using continuous day-to-day data from activity sensors integrated in global positioning system collars. We obtained data from summer 2003 to summer 2009 for a total of 16 bears

(8 males and 8 females) in Ashio-Nikko Mountains, in central Honshu Island, Japan. We evaluated the influence of food resource availability on daily active time of bears in conjunction with differences in sex and reproductive status of females (with or without offspring). The daily active time of bears fluctuated nonlinearly throughout the year. There were 3 turning points at which the activity level clearly changed from increasing to decreasing, or vice versa. Level of activity gradually increased in spring and reached a peak in July, then decreased and reached a trough in late August, and increased and reached a peak again in October. Males and females exhibited similar patterns of seasonal fluctuation in daily active time, although there were differences of activity levels between sexes during some periods. Dates of the 3 turning points did not differ between sexes, or among years. Seasonal variation in food availability may explain the timings of the turning points, at least in part. In addition, yearly variation in food resources, especially hard mast, may have affected the increasing and decreasing pattern of daily active time during autumn. Our results suggest that evaluating activity level based on pooled data without examining differences within a season (or month), and differences in year, sex, and reproductive status may result in misinterpretation.

Bear Body Language and Human Safety

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During close encounters with bears, whether in the wilds or in captivity, human safety often depends on bear tolerance and human response. Tailoring response to a bear's mood and intentions can be critical. For professionals (e.g., park rangers, biologists, wildlife viewing guides or zoo keepers) who frequently encounter bears, risk assessment and minimization require more nuanced discriminations than just predatory vs. non-predatory aggression (cf. Herrero 1985). Distinctions should also be made between anti-predator (protective) aggression, defensive vs. offensive competitive (i.e., agonistic) aggression, irritability, and various benign moods. Responses that could deter a predatory bear can aggravate a protective one. Responses that could appease defensiveness can intensify offensiveness. Mistaking playful or curious approaches for aggression can cause over-reactions that turn benign encounters into lethal conflicts. To aid in accurate recognition of moods and intentions, we compiled an ethogram of ritualized displays (e.g., weapon threats vs. challenge threats such as sumo strut, cowboy walk, stomp walk, and goose-step slide), body postures (e.g., significance of head height and jaw orientation), gestures (e.g., head turning, jaw gape), facial expressions (lip and ear positions, gaze direction, eye contact), and vocalizations (>10 varieties, numerous gradations or blendings). These are compared with body language of wolves (*Canis lupus*), felids (e.g., *Panthera spp.*), great apes, and ungulates. Between 1970 and 2013, thousands of hours of observation were made on wild and captive black bears (*Ursus americanus*), brown bears (*U. arctos*), and polar bears (*U. maritimus*). Wild habitats ranged from coastal and interior Alaska to Minnesota and New England. Each of those species, plus sloth bears (*U. ursinus*), and spectacled bears (*Tremarctos ornatus*) have been observed at numerous zoos. Behaviors were documented with audio tape, video footage, photographs, diagrams, and laptop computer. In the wild, observation of non-habituated bears was done from concealment with binoculars or spotting scope. Habituated bears were observed both

from concealment and while exposed, often at distances <100 m (brown bears) or even <10 m (black bears). Changes in body language as habituation progressed were documented. Suggestions are made for optimal responses during a variety of encounters. Examples are presented on video.

Session 19
CONSERVATION I

Linking Habitat to Demography to Assess Effects of Human Land Use on Grizzly Bear Populations in the Southwest Yukon, Canada

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Management agencies recognize the need to protect grizzly bear populations and are looking for cost-effective methods to determine acceptable thresholds for human activities. A cost-effective alternative to directly monitoring populations is to measure the effects of human activity on grizzly bear habitat. Though habitat-based methods are relatively inexpensive, models that describe resource selection are limited if they do not link habitat to demographic processes. We evaluated empirical habitat, forage distribution, and expert-opinion models with respect to explaining reproductive and annual adult survival rates. Productivity was measured as survival of cubs-of-year to yearlings for each adult female. Empirical habitat models described the relative probability distributions for family groups, all adult females, adult males, and mortality locations. Expert-opinion models were limited to habitat effectiveness and security area models. We created management units for the study area by delineating home-range sized watershed boundaries. We used the best model, established by model selection criteria, for explaining reproductive and survival rates to predict population status for grizzly bears in each unit. We categorized the status of each unit into source-like, refuge-like, attractive sink-like and sink-like habitats. Our objective was to test the performance of habitat-based methods for relaying information on demographic features and to promote informed use of grizzly bear habitat models. In comparison to resource selection and mortality risk models, habitat effectiveness and security area models were inferior for predicting productivity and survival rates. We evaluated habitat conditions, recognizing the limitation of resource selection and mortality risk spatial layers to predict productivity and survival rates. Much of the study area shows high productivity and high mortality, indicating that these areas may act as attractive sinks. With the population potentially declining, managers should focus on efforts to abate mortality risk in the areas adjacent to highways, and proactively prevent human-caused mortality in the source-like areas.

Challenging Current Paradigms of Urban Bear Management: Lessons Learned from Aspen, Colorado

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It is widely accepted by resource managers that urban bears are dependent on human resources, that such behavior is irreversible and results in "bad" or "problem" bears, and that these bears pose a threat to human safety and therefore need to be removed. Based on a 6-year study of American black bear ecology and human-bear interactions in Aspen, Colorado, we critically review these paradigms and associated factors. Overall, we ask: What is an urban bear? Is management targeting

the right bear? Is management effective in changing people's behavior to better secure attractants from bears? And can we be more successful in reducing human-bear conflicts with management that targets humans or bears? We address these questions by incorporating data and published results from the Aspen study including: (1) detailed locational (30-min intervals) and activity (5-min interval) data collected on 50 GPS-collared bears, (2) results from models related to bear resource selection, space-use, and activity patterns, (3) results from experiments to evaluate the efficacy of human-targeted education and enforcement, and (4) results from decision-support models evaluating whether reducing bear attractants or increasing foraging costs (aversive conditioning treatments) is better at preventing bears from selecting the urban environment. Answers supported by our data suggest that: bear use of urban areas can be a reversible behavior; in some cases management is targeting the wrong bears; as implemented education alone is only marginally effective in changing human behaviors but proactive enforcement can be effective; and effective management targeting humans can be more successful in reducing human-bear conflicts compared to management targeting bears. We therefore critically review paradigms of urban bear management practiced in Aspen, carefully examine whether urban bear management goals are achievable, and discuss how resources can be more efficiently and effectively allocated to reduce urban human-bear conflicts.

Coexisting with Grizzly Bears

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Environmental Education is becoming increasingly important as human populations expand into wildlife habitat, often resulting in human/wildlife conflict that can contribute to conservation challenges for populations. Meadow Creek, a small isolated rural enclave in southeastern British Columbia, Canada, has experienced a long history of conflicts with grizzly bears resulting in significant bear mortalities. The Meadow Creek Bear Management Project combines education, research, and bear conflict management to learn what works and what doesn't in context of improving a community's ability to coexist in good grizzly bear habitat that had likely become a population sink. Here I discuss how I applied improved attractant management, community education, and community involvement in a study about what works to improve human/grizzly bear coexistence. Twenty-eight resident participants with diverse values contributed to in-depth interviews and a focus group that revealed perceived barriers and potential solutions to grizzly/human coexistence. Results showed increased attitudes of tolerance since mid-2000s but that on-going support is needed to enable both bears and humans to coexistence. The most important contributions to coexistence are electric fencing to protect livestock, providing options for attractant management without giving unsolicited advice about private property management, and demonstrating that these options work. Coexistence is made more complex in this area because the Meadow Creek Kokanee (salmon) Spawning Channel attracts both bears to the kokanee and visitors who wish to view the bears. In a parallel effort within this same community, I installed 26 electric fences and controlled the attractants of 75% of the residents who needed better attractant management over 6 years. Over that time period we have seen a significant improvement in human attitudes and behaviours toward coexisting with grizzly bears resulting in a reduction in bear conflicts and in the number of bears killed as a result of conflicts. This research also suggested that coexisting with grizzly bears in Meadow Creek may serve to improve the linkage function of this area between the Central Purcell and Central Selkirk grizzly bear population units. This work may be a useful study for other communities in linkage areas between threatened populations of wildlife or areas of high human/bear conflicts.

Grizzly Bear Recovery: Progress after 33 Years of Conservation under the US Endangered Species Act

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The grizzly bear was listed as a threatened species in the lower 48 states under the US Endangered Species Act in 1975. This listing was due to almost complete extirpation due to decades of persecution. Formal recovery efforts started in 1981 with the completion of the first Grizzly Bear Recovery Plan. State and federal agencies, tribes, and Canadian provinces were organized in 1983 into a cooperative structure called the Interagency Grizzly Bear Committee to work together to implement the Recovery Plan. At the time of listing, the exact number of grizzly bears was unknown. In 2013, population estimates in the Yellowstone ecosystem are approximately 700 and approximately 1000 in the Northern Continental Divide Ecosystem. Grizzlies are expanding their range and numbers and are re-occupying some historic habitats where they had been extirpated over 100 years ago. The 4 primary tools to achieve conservation progress were mortality control, improved habitat security, improved sanitation on public and private lands, and increased public understanding and support for recovery of grizzly bears. Both the Northern Continental Divide Ecosystem and the Yellowstone ecosystem populations appear to be approaching carrying capacity as evidenced by reduced subadult survival in the core areas of the Yellowstone ecosystem and dispersal of primarily subadults into peripheral habitats in both ecosystems. Challenges remain for the 3 other smaller grizzly bear populations in the lower 48 states including fragmentation, low numbers, excessive mortality, and conflicts with extractive industry and some local residents. After 33 years of conservation effort, 95% of the more than 1800 grizzlies south of Canada are now healthy and secure. The objective of the Endangered Species Act is to get listed species to the point at which protection under the ESA is no longer required. We review the process to get to delisted status and the efforts to date in the Yellowstone and Northern Continental Divide Ecosystems. Finally, grizzly bear management and protection is contrasted under the US Endangered Species Act versus under delisted status. The long-term success of and public and political support for the US Endangered Species Act will be either enhanced or badly damaged by what happens with the recovery and delisting of the grizzly bear.

Black Bear Historical Ranges Revisited – Documenting the Increase of a Once-Extirpated Population in Nevada

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Black bears (*Ursus americanus*) were once abundant in Nevada and distributed throughout the state yet recognition of the species' historical occurrence in the state is uncommon and has therefore been ignored in published distribution maps for North America. The lack of representation on distribution maps is likely due to the lack of any scientific data or research on bears in Nevada until 1987. Historical records dating back to the 1840s compiled by Nevada Department of Wildlife (NDOW) biologist Robert McQuivey indicate presence of black bears throughout the state in the 1800s through about 1930. The paucity of historical references after 1931 suggest extirpation of black bears from Nevada's interior mountain ranges by this time. We report on historical records of black bears in the state of Nevada and the results of a current population estimate of black bears derived from a sample of marked bears (n = 420) captured 707 times between 1997–2008. Using Pradel and Cormack-Jolly-Seber models in Program MARK, we estimated overall population size, finite rate of growth (λ = 1.16), quarterly and annual survival rates for males and females, seasonal capture probabilities, and recruitment rates. Our results indicate an overall population size of 262 ± 31 adult black bears in western Nevada. These results suggest that the once abundant, then extirpated population of black bears in Nevada is increasing at an annual average rate of 16%. Although the current distribution is limited to the western part of the state, our findings suggest possible expansion of the

population into historical habitat within the interior and eastern portions of the state that have been absent of bears for >80 years. Finally, based on historical records, we present suggested revised historical distribution maps for black bears that include the Great Basin ranges in Nevada.

Urban Areas in the Mid-Atlantic: A Potential Population Sink for Black Bears?

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Spatial ecology of black bears (*Ursus americanus*) in urban and suburban environments is poorly understood. We know relatively little about where bears go, what they do, and what influences their movement patterns in such environments. Our primary research objective was to determine if movement patterns, habitat selection, and home range use of bears in suburban habitats promotes for regulated harvest as an effective management tool. We handled 108 bears with GPS/GSM collars in New Jersey, Pennsylvania, and West Virginia during 2010–2012. Due to major collar failure (>50%), we were unable to use data from all bears. Mean annual 90% fixed kernels were 9.42 km^2 ± 2.11 (SE) for females (n = 34) and 94.57 km^2 ± 12.62 (SE) for males (n = 37) after removing 3 outliers (dispersing adults). Core (50% fixed kernel) home ranges were 2.55 km^2 ± 0.53 (SE) for females and 16.33 km^2 ± 2.41 (SE) for males. Mortality of urban black bears in Pennsylvania was ~3 times higher than reported in other studies from the region. Mortality in West Virginia and New Jersey was ~1.5 times higher than reported in other studies from the region. Regulated harvest may be a potential tool to kill problem bears, however, the majority of all bears harvested (76%) were male. It can help remove problem bears and function as a liming factor for the population, but harvest (at the current levels) will likely not function as a regulating factor for the population. Vehicle collisions were another important source of mortality (30% of overall mortality), especially to females (5:6 females to males killed in vehicle collisions). Reproduction in urban areas was relatively high (~3 cubs per litter). Given the high mortality and high reproduction, urban/suburban areas in the Mid-Atlantic may be functioning as attractive sinks.

A Community-Based Approach to the Conservation of Andean Bears

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The Spectacled Bear Conservation Society (SBC) and San Diego Zoo Global (SDZG) have been studying a population of Andean bears *(Tremarctos ornatus)* in the Tropical Dry Forest of the western foothills of the Andes. Although this threatened species is generally found in humid alpine habitats, a population of approximately 20 bears survives in the extremely challenging dry forest environment. This region, encompassing the La Leche River watershed, contains high levels of endemism, and is a remnant of what was once a more widespread habitat. SDZG and SBC have identified that the South American sapote tree, *Colicodendron scabridum*, holds a vital role in the survival of the bear and other threatened species, yet little is known about it. Although recognized as Critically Endangered by Perú, sapote is among the trees most heavily used by humans. The low elevation portions of the La Leche River watershed, where sapote grows, coincides with several rural villages where the inhabitants are not aware of its importance to the forest, the Andean bear, and other species. These communities regularly clear sapote to create agricultural fields, or for use as firewood and construction materials. Andean bears in this region have an unexpected tolerance to human presence, such that they feed on sapote even when it grows close to human dwellings. These observations are increasing as human habitations expand further into forests. We have observed dramatic temporal variation in body condition of dry forest bears depending on whether sapote fruit is available to them, or not. Thus, a major gap in the conservation of Andean bears and the Tropical Dry Forest involves building local community support for the conservation of the Andean bears. This gap can be best addressed by building awareness and

knowledge of the unique value and threatened nature of the bears and the ecosystem. SDZG and SBC have been working to develop conservation capacity in the communities surrounding critical Andean bear habitat. Because a major threat to Andean bears in the wild is habitat fragmentation, our focus lies in promoting consciousness about forest degradation. This includes reducing the amount of firewood used by individuals, training local teachers, relaying information to the general community, involving citizens in data collection, and providing avenues for alternative livelihoods. Thus far, we have established a small network of women trained in the art of wool-felting, we have conducted professional development workshops for teachers in primary and secondary schools, and we are exploring how to introduce highly fuel-efficient stoves into communities, and train local citizens to collect data. The combined experience and position of SBC and SDZG researchers, conservation educators, and the local parabiologists makes an ideal platform for implementing conservation education and outreach initiatives for Andean bears. The outcomes from these initiatives are long-term, self-sustaining activities that are evaluated and refined during implementation. All initiatives will be mutually beneficial to both the conservation of the forest and the well-being of local communities.

Session 20
ECOLOGY III

Variation in Brown Bear Kill Rates on Moose in Sweden

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Moose hunting in Sweden is important from both an economical as well as a recreational perspective. The recent increase in both geographical distribution and numbers means that the bear distribution now overlaps with a large proportion of the moose distribution. Brown bears are important predators on moose and the effect of predation needs to be taken account of in the management of the moose population.

We used clusters of GPS positions from radio-collared bears in 2 study sites, located in both the southern (n = 18) and northern (n = 22) range of the bear population, during the moose calving season in combination with field visits to verify predations.

Kill rates (i.e. kills per bear and season) on moose calves were similar in the southern (7.6 ± 0.71, mean and SE) and northern study areas (7.3 ± 1.1), but significantly higher on adult moose in the north (2.3 ± 0.4 vs 0.1 ± 0.1). The variation in kill rates ranged from 0–21 moose calves per bear and season.

Moose densities were higher in the northern study area, but bear densities were lower. In addition, the bears in this area also had access to and killed large amount of semi-domestic reindeer calves.

Our findings are in line with previous conclusions that brown bear diet is more carnivorous in areas with lower temperatures and more severe snow conditions. We also conclude that the effect of bear predation on the moose population is higher in the north, due to higher predation on adult moose, significantly affecting the trajectory of the population, and therefore needs more consideration within moose management.

Assimilated Diet Patterns of American Black Bears in Urban and Wildland Regions in the Sierra Nevada of Nevada, USA

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In Nevada, the American black bear (*Ursus americanus*) has learned to coexist with humans in an environment of increasing urban sprawl. Black bears thrive in this human-dominated environment where they forage in areas surrounded by hotels and casinos which regularly dispose of high quality, protein-rich foods providing a high caloric value. We examined the extent of exploitation of anthropogenic foods by black bears in Nevada and assessed differences among different sex and age classes. We used stable carbon and nitrogen isotope analysis of 153 hair samples from black bears captured in the Sierra Nevada Mountains from 2003–2010. Enriched stable carbon (δ13C) isotope signatures indicate anthropogenic food sources whereas enriched nitrogen (δ15N) indicate increased protein in the diet. Compared with stable isotope signatures of potential food items among local flora , the assimilated diet of black bears was enriched by 4.70‰ for $\delta^{15}N$ ($t = -11.03$, $P < 0.001$) and 7.72‰ for $\delta^{13}C$ ($t = -30.98$, $P < 0.001$). Furthermore, we found a positive correlation between these enriched $\delta^{15}N$ and $\delta^{13}C$ signatures of bear samples ($r = 0.65$, $P < 0.001$), indicating use of anthropogenic food sources. We developed a set of *a priori* models to examine if sex, age class, urban or wildland classification, season, molt, or year affected stable isotope signatures. There were differences in $\delta^{15}N$ for pre-molt (1 January–30 June) vs. post-molt (1 August–31 December) phases of hair collection, sex, and mass. Hair samples collected during the post-molt phase represented the late spring and early summer diet were less enriched for $\delta^{15}N$ compared with pre-molt hair samples (ß = –0.68‰, $p = 0.002$). Male black bears had enriched $\delta^{15}N$ compared with female black bears (ß = 0.73‰, $p = 0.0003$). Bears in above average and average weight categories had enriched $\delta^{15}N$ signatures compared with bears of below average weight (ß = –0.31‰, $p = 0.002$). We found differences within the population for $\delta^{13}C$ with molt phase and mass. Post-molt hairs were less enriched relative to pre-molt hairs (ß = -1.12‰, $p = 2.12\ e^{-05}$) and bears in above average and average weight had enriched $\delta^{13}C$ signatures compared with bears of below average weight (ß = 0.61‰, $p = 0.0001$). Our results indicate substantial enrichment of Nevada black bear diets ($\delta^{15}N$ μ = 5.38‰, SD = 1.35; $\delta^{13}C$ μ = –20.20‰, SD = 1.60) compared with other black bear populations in the United States. This overall enrichment and positive correlation between $\delta^{15}N$ and $\delta^{13}C$ indicates that the bears in Nevada have access to high-quality food with a high protein content and likely anthropogenic food source. And, importantly, almost all bears within the population exploit this food source. An important implication for management is that targeting specific segments of this bear population to control nuisance bear activity may not be effective. Rather, it may be of more value to address the source of available anthropogenic foods across the landscape.

Direct Observation of Bear Myrmecophagy: When and How do Bears Eat Ants?

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We studied the ant-feeding behavior of Asiatic black bears (*Ursus thibetanus*) through direct observation in the Ashio area of Japan. We recorded the bears' "time foraging per ant nest" (TPN), documented the seasonal occurrence of ants in their scats, estimated phenological changes in caste composition of the nests of two abundant ant species (*Lasius flavus* and *L. hayashi*), and calculated the nutritional composition of queens, males, workers, queen pupae, and non-queen pupae of both species. We addressed 2 main hypotheses: (1) ant-nest phenology, especially the availability of pupae, affects

bears' myrmecophagy level; and (2) TPN changes according to the caste composition of ant nests. Bears in the Ashio area consumed more ants than in previous studies elsewhere in Japan, with consumption peaking in early July. The availability of pupae may trigger ant feeding by bears. And, because queen pupae were heavier than members of other castes, calories per individual were higher. TPN varied during the study period (late June–early August). There was a negative relationship between frequency of occurrence of pupae in ant nests and TPN; because pupae cannot move by themselves, bears could consume them effectively and quickly. Thus, bears may change their ant-foraging behavior (especially TPN) based on ant nest composition.

Session 21
CONSERVATION AND PUBLIC OUTREACH

Inadequate Environmental Assessment Mitigation for Large Industrial Projects Undermines Bear Conservation

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Industrial development projects have contributed to widespread adverse environmental effects to wildlife and their habitat despite being subject to Environmental Assessment (EA) processes. The capacity to offset adverse environmental effects from these projects though mitigation has not been widely examined for bear (*Ursus spp*.) populations in Canada. The present study examined 2 central problems: popular methods used in EAs, and the basic needs for improving mitigation programmes for bears. Experts (n = 48) from three different occupation groups (government, consulting, and academic/environmental non-government) were interviewed. Interview data was used to evaluate current bear mitigation approaches and identify opportunities for improvement. The interviews revealed little to no mitigation was implemented for bears despite commitments stated in the EAs. The lack of mitigation was related to limited resources in terms of funds and personnel, and/or failure to prioritize bears because of bureaucratic challenges. Sometimes bear mitigation was included in EAs simply to obtain project approval and permits. When mitigation was performed, experts reported ineffective monitoring and follow-through on almost all mitigation programmes. Experts identified approaches that would improve bear mitigation, such as the desire for a long-term vision and obligation, and better guidelines and standards. The need for accountability, ownership, and due diligence was also acknowledged. Addressing these needs could improve bear mitigation and reduce adverse environmental effects drastically. If these recommendations were implemented, major conservation benefits could be realized and would ultimately improve the EA process. Failure to address major problems in the EA process will only continue to jeopardize conservation efforts.

Evaluation of Current Knowledge Relative to the Impacts of Human Recreation on Bears in North America

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Wildlife managers throughout Alaska, Canada, and much of the United States are often faced with making decisions about how to manage and regulate human activities in bear habitats. A wide variety of recreational and commercial activities take place in bear habitats including bear-viewing, hunting, fishing, snowmobiling, skiing, hiking, sea-kayaking, river rafting, oil and gas development, camping, and others. In response to the need for scientific information on which to base management

decisions about human activities in bear habitats a vast number of studies have been conducted. Most of these studies focus on assessing the potential impact of a specific type of human activity on an individual population of bears. However, managers of large tracks of land, including state and federal agencies, are faced with balancing a wide-range of human uses and activities in bear habitats. This study sought to review and summarize the available literature on the responses of bears to human activities common to North America, occurring within the habitats of black, brown, and polar bears.

Capture-Related Mortalities in Brown Bears in Scandinavia 1984–2013: A Review of 1,824 Captures

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The Scandinavian Brown Bear Research Project (SBBRP) conducted a total of 1824 brown bear *(Ursus arctos)* captures from 1984 through February 2013 for research and management purposes. Capture-related mortality rates during the capture event and during a 30-day post capture period were 0.8% (n = 14) and 0.1% (n = 2), respectively. From 1984 through 1991, bears were immobilized from a helicopter with either etorphine or medetomidine-ketamine and seven capture-related deaths (3.4%) occurred in 174 captures. Six of these deaths occurred when bears were immobilized with etorphine: 3 due to stress, hyperthermia and/or respiratory depression (one of these animals had only one functional lung), 2 due to drowning, and one due to dart trauma (pneumothorax). In addition, one bear immobilized with medetomidine-ketamine was shot for human protection after a spontaneous recovery from anesthesia. From 1992 through 2012, a total of 1625 captures were carried out from a helicopter with medetomidine-tiletamine-zolazepam (MTZ). Seven bears (0.4%) died during the capture event using this protocol: 3 because of shock/circulatory failure, 2 due to drowning, and 2 due to dart trauma (penetration of the thoracic cavity). Two bears (0.1 %) died during the 30-day post capture period: one due to unknown causes (necropsy not conclusive) after 3 days and one due to wound dehiscence 14 days after surgical implantation of an intraperitoneal radiotransmitter. We also conducted 25 captures of hibernating subadults during February–March in 2010–2013 with no mortality, using a modified anesthetic protocol based on medetomidine-ketamine-tiletamine-zolazepam (MKTZ). We recommend the current SBBRP protocols for capture of denning (MKTZ) and non-denning (MTZ) brown bears.

Human–Black Bear Interface in Annapurna Conservation Area of Western Nepal

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Out of 3 species of bear recorded in Nepal, the Asiatic black bear (*Urusus thibetanus*) is one of them which is also the resident for Annapurna Conservation Area (ACA). ACA, the first conservation area and the largest protected area of Nepal is pioneer for the implementation of integrated conservation and developmental model not only in Nepal but also for the world. The people residing inside ACA are found to be seriously affected from human-wildlife conflict.

Black bear is one of the species which caused the serious injury to human beings and crop riding and also victimized itself as a retaliatory killing. Therefore the research was conducted with the aim of exploring the current status of the species, its distribution, feeding species, and interaction with the human beings. Field survey was conducted to determine the relative abundance of the species. Thirty days of field work was conducted in April and May in 2012. Potential habitat was identified through the discussion with local community, animal herder, and key informant surveys. The injured people and affected community from the black bear were taken as the key informants. Transects each of 500 meters long were laid across the potential habitat covering the different forest types and altitudinal range. The research covered the 2 VDCs of ACA. Altogether 5 scats, 4 pugmarks and 3 scraps were recorded in Shikha VDC however one scats, 3 pugmarks and 5 scrapes were recorded in Parche VDC. *Arundinaria spp., Quercus glauca, Arisaema wallichianum, Girardiana diversifolia, Dryopteria spp., Berberus spp., Garuga pinata* and *Rubus spp.* were found to be consumed by black bear. Altogether 7 individuals were found to be injured from the black bear out of them 3 were seriously injured. Previously there was the problem of livestock depredation but it has not been recorded since last 8 years because of significant reduction in the no of animal herders. Seventy six households were found to be affected from the crop damage. The maize damage only is equivalent to 2000 USD besides these millet and buckwheat were also found to be damaged. Therefore the livelihood of the local people residing near by the forest area is found to be greatly affected. The crop riding is increasing than before. More than 80% respondent said that it is due to the increase in the black bear population. Annapurna conservation area project (ACAP) is providing the compensation for the human attack and livestock depredation but not for the crop riding. Although the local community has been implementing the traditional methods to prevent the crop damage from the black bear it is not so much effective. Scarecrow with the solar light in the crop field during the high sensitive time may be the one of the effective way which need to be trialed. ACAP is going to trial a solar fencing in the main entrance of black bear in the year 2013.

Determining Causes of Genetic Differentiation in an Isolated Large Carnivore (*Ursus americanus*) Population to Identify the Need for Conservation Actions

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Most conservation studies focus on populations that are geographically and genetically isolated. To avoid future extirpation of currently widely distributed large carnivores, identifying processes explaining genetic distinctiveness in segments found adjacent to core populations has become necessary. In Ontario, Bruce Peninsula (BP) black bears display reduced genetic diversity, while being adjacent to a highly diverse core. Here, we conducted forward simulations to identify the reasons for this low diversity. We tested for historical genetic drift, recent demographic bottleneck, recently reduced migration, and

a combination of recent population crash and reduced migration. We also used simulations to assess the need for genetic restoration through translocation efforts. Comparisons of simulated and empirical genetic diversity measures supported a recent bottleneck involving 2 drops in population size, associated with reduced migration. A low genetic diversity similar to the one observed on the BP was also detected when simulating 0.5 migrants per generation over 4000 years, an unlikely scenario considering the dispersal abilities of black bears. In addition, the fact that black bears located on a neighbouring island (Cockburn Island) had a higher diversity than BP individuals further supports that long-term, highly reduced migration, is not what explains the reduced diversity on the BP, and that demographic events played a role. BP black bears could retain at least 80% of their current diversity over the next 100 years, and translocations could only help increase genetic diversity on the short-term under geographic isolation. As such, landscape management allowing a continuous intake of migrants from the contiguous Ontario bear population would be an effective method to enhance long-term genetic diversity. However, this might not be achievable given the anthropogenic footprint in southeastern Ontario, and regular translocations of bears into the BP might become required if reduced genetic diversity begins to impede the fitness of this population.

Comparing Two Techniques for Rapid Assessment of Brown Bear Abundance in Romania

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There is high uncertainty around the European brown bear (Ursus arctos) estimates in the Romanian Carpathians, which affects the ability of management agencies for setting ecologically meaningful hunting quotas. Current estimations of abundance are not based on systematic surveys, do not rely on modern statistical techniques, and lack estimates of uncertainty. Moreover, financial constraints do not allow for implementing intensive studies, such as DNA-based mark-recapture. In this study, we tested the use of 2 cost-effective sampling techniques for estimating brown bear abundance from unmarked individuals in an occupancy framework: (1) track counts on 2-km forest road segments, and (2) camera traps within 3 3 km grids. We collected track count and camera trap data using repeated surveys during 3 seasons (Spring and Fall 2011, and Spring 2012) in 4 Hunting Management Districts (HMD) in the Eastern Carpathians. From track data recorded on snow or mud, we estimated mean seasonal abundances per transect (and 95% Credible Intervals) of 1.34 (0.96–2.70), 1.65 (0.72–3.72), and 1.43 (0.88–3.00) bears/transect, respectively. Camera trap data was less reliable, with insufficient detections during Spring 2011; the mean abundances were 1.29 (0.40–3.52) and 2.78 (0.58–5.95) bears/3 x 3 km grid for the last 2 seasons. Detection probability varied across seasons (0.2–0.5), and was consistently lower for camera traps (0.2–0.25). Variables used to model abundance had low explanatory power. Using the track data estimates, and considering a mean home range of 14 km^2 (calculated for the duration of our sampling), we calculated densities of 10 (7–17), 12 (5–25), and 10 (6–18) bears/100 km^2 for the 3 seasons. We conclude that when using unmarked animals, track count data yields more reliable estimates of brown bear abundance compared to camera traps. As the next step, we suggest implementing a mark-recapture DNA-based study to validate our estimated abundances.

Proposal for the Creation of a Natural Corridor for the Andean Bear (*Tremarctos ornatus*) in the Northwest of the Metropolitan District of Quito-Ecuador

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Since 2008 at least 35 Andean bears *(Tremarctos ornatus)*, in all life stages, have been identified through direct observations and camera traps in an area of approximately 200 km^2 within the northwest of the Metropolitan District of Quito. These bears live, feed, move and reproduce in a territory that presents a mixed landscape including important remnants of natural forests and areas for production and extraction activities. Despite the fact that the Andean bear is endangered and protected by law in Ecuador, and that the area where these bears live is partially protected, their survival is compromised in the near future. The presence of different types of threats, including the expansion of agriculture and livestock, logging, hunting, the presence of roads and highways, among other human activities, are constantly reducing and disconnecting the bear's habitat. The Environmental Secretary of the City Council of Quito, in cooperation with the University San Francisco of Quito, proposed the creation of a natural corridor for the Andean bear in the area. The corridor will connect different state and private protected areas providing additional effective habitat for the bears. The corridor has been designed to ensure the availability of food and the dispersal and reproduction of individuals and aims to guarantee the survival of bears, allowing them to move free and safe, even in areas with presence of people and artificial barriers like highways. The main objectives of this project were (1) to identify the movement patterns of bears, especially along the Guayllabamba river and the Calacalí-Nanegalito Highway; (2) to perform a preliminary ecological characterization of the area in order to establish the limits of the corridor related to the availability of effective habitat, connectivity, and the presence of threats; and (3) to initiate processes of environmental awareness and involvement of local actors, academic institutions, government organizations, and the civil society in the conservation of bears and the forest they inhabit. The importance and the charisma of the Andean bear, and the proximity of the corridor to the city of Quito presents several opportunities in terms of conservation, tourism, and local development. The creation of the corridor and its effectiveness will be achieved only promoting a sustainable and controlled use of the land, providing alternative economic activities to local people, and especially involving the citizens of Quito in the conservation of the Andean Bear.

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