Wildlife Professionals: Agency Coordination & Collaboration

(sorted by presentation order)

BRIDGING SCIENCE AND MANAGEMENT - THE ROLE OF REGULATIONS IN CONSERVING CALIFORNIA'S WILDLIFE

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It is broadly recognized that science is vital to achieving wildlife management goals. Yet, the process by which the "best available science" is integrated into decisions affecting conservation and management may not be clear to the public, despite the fact that the outcomes may change how they enjoy California's wildlife and habitats. The Regulations Unit (RU) at the California Department of Fish and Wildlife often works closely with the Fish & Game Commission (Commission) to prepare regulatory documents that synthesize data, public input, and alternatives to inform decisions affecting land and habitat use, sensitive species, game harvest, and commercial activities. When either agency faces a regulatory action decision that has potentially significant socioeconomic and management implications, the RU and Commission staff strive to minimize bias, facilitate transparency, and acknowledge limitations of the data, including the analysis and interpretation of it. From annual syntheses on the effects of harvest for game birds and mammals, to sport and ocean fishing, to regulatory adjustments mandated by recent legislation or litigation, the RU helps facilitate the communication of the science behind decisions and management recommendations. This presentation navigates through the rulemaking process and how it connects science and management.

Wildlife Professionals: Agency Coordination & Collaboration

DEVELOPING AND ENHANCING PARTNERSHIPS WITH NATIVE AMERICAN TRIBES TO SUPPORT CROSS-BOUNDARY WILDLIFE CONSERVATION

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Tribal lands encompass over 56 million acres of lands in the United States and are often remote, undeveloped lands that provide ample habitat for wildlife species of concern. Federal, state and NGO land management entities with goals of maintaining and supporting wildlife communities have legal and moral obligations to appropriately and respectfully coordinate and engage with federally recognized tribal communities when management actions impact tribal values at risk. For the USDA Forest Service, shared stewardship and cross-boundary work is a fundamental pillar with goals of tribal engagement and consultation at the forefront. This presentation highlights the opportunities for building partnerships with federally recognized tribes in California and Nevada and shares some recommendations for building meaningful relationships. An emphasis on tribal land stewardship, traditional knowledge and Native practices will highlight the urgency of building tribal partnerships in the 21st Century to support wildlife conservation.

Wildlife Professionals: Agency Coordination & Collaboration
ENVIRONMENTAL ADVOCACY: PARTNERSHIPS FOR PUBLIC TRUST

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Golden Gate Audubon Society (GGAS) is a non-profit environmental advocate for protecting native bird populations and their habitat in the wider San Francisco Bay area. Effective public comments on proposed actions derive from research on impacts and avoidance measures. For example, baseline studies and monitoring protocols for studying impacts from turbines improved our understanding of the avian and bat mortality at wind farms. The Altamont Pass Wind Resource Area (APWRA) Programmatic Environmental Impact Report (PEIR) pursuant to the California Environmental Quality Act (CEQA) resulted from advocacy for biological studies of avian and bat impacts from wind farms. The APWRA PEIR is an example of GGAS partnerships for protecting wildlife as a public trust. Wildlife and habitat protection from recreational impacts need similar research. However, land planners and managers need help. Environmental advocacy helps land managers protect wildlife and habitat as a public trust but public support is eroding. Advocates need more research to support public comments and strengthen policies for protecting wildlife.

Wildlife Professionals: Agency Coordination & Collaboration

A COLLABORATIVE APPROACH TO MEADOW RESTORATION

Bennie Johnson Howell; Collins Pine Company; 500 Main Street, Chester, CA, 96020; (757) 329-5055; bjohnson@collinsco.com; Andrea Craig, Kristen Wilson, Ryan Burnett, Sheli Wingo, Kim Cook, Sarah Yarnell, Damion Ciotti, Karen Pope

Collaboration is defined as the action of working with someone to produce or create something. Often, without collaboration, producing a meaningful product is difficult. In the wildlife field, property boundaries, financial restrictions, legal requirements, and other hurdles can make even the simplest of projects difficult to implement. We use Childs Meadow, a headwater meadow affected by land management, as an example to demonstrate how a collaborative effort between a private landowner, state and federal agencies, universities, and NGOs can provide multiple benefits to a headwater system. Childs Meadow occurs in western Tehama County at the junction of the southern Cascades and northern Sierras. Some of the ongoing management at the meadow includes cattle grazing, timber harvest operations, and beaver dam analogues. Further, many RTE species occur in this meadow complex, including a recently petitioned species, Cascades frog (Rana cascadae). We use Cascades frog as an example species to demonstrate the power of collaborative efforts and how private landowners can contribute to conservation efforts.

Wildlife Professionals: Agency Coordination & Collaboration
Ecology and Conservation of Amphibians and Reptiles

PHYLOGEOGRAPHIC ORIGIN OF CALIFORNIA SLENDER SALAMANDERS (BATRACHOSEPS ATTENUATUS) IN THE SUTTER BUTTES

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The phylogeny of California Slender Salamanders (Batrachoseps attenuatus), which inhabit Northern California's Coast Ranges and Sierra Nevada foothills, was previously investigated by Martinez-Solano et al. (2007) who recovered a monophyletic species that contained five geographically cohesive major clades. However, a population isolate of B. attenuatus found in the Sutter Buttes, a geographically isolated volcanic mountain range within the Sacramento Valley, was not included in their phylogenic analysis. We sequenced ~780 base pair segment of the mtDNA cytochrome b (cytb) gene used in Martinez-Solano et al. (2007) to examine the phylogenic placement of this isolated population within the B. attenuatus complex. Our results, based on a single mitochondrial marker, indicate that the Sutter Buttes population of B. attenuatus is a well-supported monophyletic group nested within the Sierran segment of the "East Bay / Sierra" Martinez-Solano et al. (2007) subclade, which is in turn nested within their "Eastern" major clade. Although we cannot accurately estimate how long the Sutter Buttes population has been isolated, B. attenuatus was likely able to colonize the Sutter Buttes during pluvial Pleistocene interglacials when more contiguous woodlands may have opened dispersal corridors across the Great Central Valley.

Ecology and Conservation of Amphibians and Reptiles

IN SITU POPULATION ENHANCEMENT OF AN AT-RISK POPULATION OF FOOTHILL YELLOW-LEGGED FROGS, RANA BOYLII, IN THE NORTH FORK FEATHER RIVER, BUTTE COUNTY, CALIFORNIA.

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The Cresta reach of the North Fork Feather River historically had a relatively robust population (30+ breeding females) of foothill yellow-legged frogs (Rana boylii). The population in this regulated river reach has been steadily declining since the early 2000's, due to a suite of factors including recreational whitewater flows, hydroelectric dam operations, predation from introduced predators and increased riparian vegetation in breeding habitats. A collaborative group is working to increase the critically small population size of foothill yellow-legged frogs. The 2017 population included as few as five adult females based on 2017 egg mass counts and adult captures. Egg masses were salvaged or portions of egg masses were collected for captive rearing in early June from 2017-2019. Tadpoles were reared in situ utilizing flow-through cages. Cages were visited every 2-3 days for feeding, cage cleaning, and repositioning due to fluctuating water levels. Both tadpoles and recent metamorphs were periodically released each year between July and the end of August. Three years of post-implementation surveys have revealed increasing indices of young-of-year juvenile frogs and increased egg mass counts. These promising results demonstrate that in situ rearing may be a viable management option for small populations of amphibians at risk of extirpation.

Ecology and Conservation of Amphibians and Reptiles
CONSERVATION ASSESSMENT OF THE CALIFORNIA LEGLESS LIZARD (*anniella*)

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The California legless lizard, *Anniella*, is a fossorial lizard that is found only in California and Baja California, Mexico. In 2013, four new species of California legless lizards were described using genetic and morphological techniques. The description of these new species prompted a need to define their distribution and conservation status. We conducted surveys and genetic analyses to better understand the distribution of *Anniella* species and further test the validity of the newly described species. The genetic evidence for the new species was bolstered by analysis of nuclear DNA markers that correspond to the groupings recovered by mitochondrial DNA, chromosomes, and morphology. The results of the project also greatly enhanced our understanding of the known ranges of *Anniella* species within California. We have concluded that *Anniella* species should continue to be afforded special status in California as five distinct species and the possibility of a federal or state listing for *A. alexanderae* should be explored. Additional recommendations resulting from this project include conducting a systematic study using genomic methods, continuing morphological studies of museum specimens using micro computed tomography, conducting additional field surveys for *Anniella*, and refining Ecological Niche Models with high resolution categorical data.

Ecology and Conservation of Amphibians and Reptiles

THE IMPORTANCE OF SHRUBS TO THE THERMAL ECOLOGY OF BLUNT-NOSED LEOPARD LIZARDS

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Ectotherms such as reptiles may be disproportionately affected by the projected increase in global temperatures. The blunt-nosed leopard lizard (*Gambelia sila*) is an endangered lizard whose geographic range has decreased dramatically. Some populations associate with Mormon tea shrubs (*Ephedra californica*), which may serve as important thermal buffers from the heat, allowing them to stay above ground longer. Could shrubs be used as a management tool to protect this species from rising temperatures that threaten to surpass their preferred temperatures and upper thermal tolerance? To test this, 20 *G. sila* from a "shrubbed" site and 20 *G. sila* from a "shrubless" site in the Carrizo Plain National Monument were fitted with temperature-sensitive radio collars and tracked throughout their active season. In July, each lizard's collar was removed and their preferred body temperature was determined. Lizards at the shrubless site spent significantly more time in burrows, and lizards at the shrubbed site may thermoregulate closer to their preferred temperature than their shrubless counterparts. Shrubs therefore allow lizards to be active longer above ground, presumably facilitating mating, feeding, and territorial defense. This study has direct management implications for *G. sila* as well as other species of lizard with similar habitats and physiologies.

Ecology and Conservation of Amphibians and Reptiles

DISTRIBUTION AND OCCUPANCY OF NORTHWESTERN POND TURTLES AND RED-EARED SLIDERS IN THE SACRAMENTO VALLEY AND SACRAMENTO-SAN JOAQUIN RIVER DELTA

Ecology and Conservation of Amphibians and Reptiles

Student Paper
The northwestern pond turtle (*Actinemys marmorata*) was once commonly found throughout the Sacramento Valley and the Sacramento-San Joaquin River Delta. Much of their range has been converted into agricultural land restricting and altering suitable aquatic habitats. In addition, red-eared sliders (*Trachemys scripta elegans*) have been introduced widely through their range bringing potentially detrimental competition for resources. While this area has been surveyed for turtles before, that work primarily focused on rivers, lakes, and conserved wetlands. Little is known about where northwestern pond turtles and red-eared sliders occur in the vast expanses of agricultural land throughout the Sacramento Valley and Sacramento-San Joaquin River Delta. We surveyed 142 trapping locations (102 irrigation canals, 40 wetlands) from San Joaquin County to Butte County during the summers of 2018-2019 using aquatic hoop nets. We captured northwestern pond turtles at 30 sites and red-eared sliders at 28 sites, and co-occurrence was rare. Red-eared sliders were primarily found at sites near the Sacramento metropolitan area, whereas northwestern pond turtles were more common in less populated area. Our work provides a picture of how northwestern pond turtles and red-eared sliders occupy this modified agroecosystem which is of great importance for future conservation efforts.

*Ecology and Conservation of Amphibians and Reptiles*

**THE COLOR OF CONSERVATION: ANALYZING COLOR POLYMORPHISM IN THE GIANT GARTERSNAKE**

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Reptiles exhibit wide varieties of color patterns that vary within species. However, little is known about how such color polymorphisms are associated with reptiles in fragmented and heavily modified habitats. The demographics of the federally threatened giant gartersnake (*Thamnophis gigas*) have been extensively studied, but while color polymorphism in giant gartersnakes has been anecdotally observed it has never been formally quantified. Color polymorphism in other water snake species has been linked to both increased fitness advantages and increased predation risk. To determine whether different giant gartersnake subpopulations exhibit different color polymorphisms, we examined how levels of melanin varied throughout 5 water basins in their range. Using standardized photographs, we quantified the degree of melanin in 600 giant gartersnakes by scoring the percentage of black on individual scales on a semi-discrete scale. Lower melanin scores corresponded with lighter overall coloration. Using ANOVA, we found snakes within the water basin with the highest proportion of wetland habitat exhibited significantly lower melanin scores relative to snakes occupying basins dominated by irrigation canals. Our results indicate levels of color polymorphisms vary among giant gartersnake subpopulations. Furthermore, interactions between habitat and coloration may ultimately affect reproductive success or survival in this species of conservation concern.

*Ecology and Conservation of Amphibians and Reptiles*  

**Student Paper**
Ecology and Conservation of Bats

THE GREAT CAUSEWAY BAT COUNT: CAN COMMUNITY SCIENCE AND DATA MINING GENERATE RIGOROUS POPULATION DATA?

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What may be the largest colony of any species of bat in California inhabits a 3.6 km freeway bridge between a university town and the capital city, Sacramento. The Mexican free-tailed bats (*Tadarida brasiliensis*) are well loved, thanks to the existing Yolo Basin Foundation Bat Walk programs that enchant thousands of visitors each summer. Yet the colony is virtually unstudied, and the most basic demographic data - a reliable current estimate of population size - is missing. To address this gap, we developed the Great Causeway Bat Count, a biannual event gathering community members to tackle population monitoring for a roost site that defies typical count methods. This talk will discuss the scientific and societal benefits of the first two years of community science, touching on statistical challenges and how data from this community science event may leverage other technological approaches to track a difficult-to-study population.

*Ecology and Conservation of Bats*

AN ADAPTIVE SAMPLING APPROACH TO ESTIMATING THE NUMBER OF HIBERNATING BATS AT LAVA BEDS NATIONAL MONUMENT

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Lava Beds National Monument provides hibernation habitat for the largest known population of Townsend's Big-eared Bats in California. Counts of hibernating bats have been conducted for decades, but these counts relied on the few hibernacula that had been found opportunistically. We sought an estimate for the total population of bats in the park as well as a monitoring plan that could be implemented with limited personnel. Because there are over 780 caves in the park it is infeasible to survey all the caves and, we presumed, all caves were not equal in the probability of providing hibernation habitat to bats. In 2013, we began implementing an adaptive monitoring program aimed at estimation of the full population of hibernating bats in the park. Caves were categorized according to previous bat counts and physical characteristics of the cave. We randomly selected caves from categories and surveyed 55-119 caves per year. We used these results to estimate the annual population and inform monitoring in the subsequent year. We present our estimate of population size estimates and their trends since 2013 and offer a prospectus on how our estimation methods could be used to determine population sizes of bats in other situations.

*Ecology and Conservation of Bats*

BATS OF THE CALIFORNIA CHANNEL ISLANDS: NEW RECORDS WITH NEW METHODS

Patricia E Brown; Brown-Berry Biological Consulting; 134 Eagle Vista, Bishop, CA, 93514; (760) 920-
Eight bat species were documented from the California Channel Islands at the First California Islands Symposium in 1965 (Von Bloeker 1967). Methods of detecting and identifying bats have changed (Brown and Rainey 2018). Museum collection methods using shotguns have been replaced by mist-netting and recording of echolocation signals. Currently, capture or acoustic records have identified 14 bat species on six of the eight California Channel Islands, with occasional sightings of flying bats on the other two. Bats now compose 78% of the native mammals on the islands (Collins 2012). Recorded echolocation signals are recognized as valid "vouchers" if the species emits calls that are separable from others. For year-round monitoring, the authors have installed long-term acoustic recording equipment on three of the islands. Echolocation signals have identified western red bat (*Lasiurus blossevillii*), hoary bat (*Lasiurus cinereus*), western yellow bat (*Lasiurus xanthinus*), and Mexican free-tailed bat (*Tadarida brasiliensis*) from San Nicolas Island, and western mastiff bat (*Eumops perotis*) and canyon bat (*Parastrellus hesperus*) from Santa Cruz Island. As acoustic monitoring and other techniques are used more extensively, the number of species documented may increase and the proportions that are resident, vagrant, or transient on each island can be better resolved.

*Ecology and Conservation of Bats*

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**ROOSTING ECOLOGY OF WESTERN BATS: THE OTHER CALIFORNIA REAL-ESTATE BATTLEGROUND**

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Bats select roost habitat to optimize for thermoregulatory environment, protection from predators, and social factors. However, roost habitat type and availability vary widely across ecological gradients and in response to anthropogenic structures, habitat management, and habitat connectivity. We are conducting radio-telemetry studies to determine roost habitat selection across 3 different regions in California (Marin County, Pinnacles National Park, and Sequoia/Kings Canyon National Park), for a suite of species that occurs across the Western US to learn about roost habitat selection plasticity, frequency of roost switching, variation between summer and winter habitat selection, and movement distances between roosts. We will present preliminary results from 2 years of telemetry research from Pinnacles National Park and Marin County open spaces, and 1 season of Sequoia National Park telemetry. Learning about roost habitat selection can inform monitoring and management of bat populations, which is becoming increasingly important in response to White-nose syndrome and other conservation challenges that western bats face.

*Ecology and Conservation of Bats*

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**NOTES FROM THE FIELD: RECENT LESSONS IN BAT ACOUSTIC MONITORING AND FURTHER SUGGESTIONS TO UP YOUR GAME**

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Wisdom blossoms with knowing what you don't know. Attentive tracking of bats, recording, and analyzing their vocalizations continues to improve the calibration of what we can infer from this type data. The equipment used, methods of deployment, recording conditions, and variation in call types that bats use for particular maneuvers all influence the confidence of end product results. This talk will provide guidance on how to deploy acoustic recording equipment for bat surveys in ways to avoid unexpectedly easy pitfalls to yield the highest quality data. Recognizing species-discriminating call types from ambiguous types
provides an essential check for species presence confirmation. This talk will present some key features and methods to recognize when to confirm species, and when to leave them unidentified.

Ecology and Conservation of Bats

WHAT'S THAT SOUND? ACOUSTIC MONITORING OF LITTLE BROWN BAT (MYOTIS LUCIFUGUS) SEASONAL ACTIVITY IN A HISTORIC BUILDING

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The little brown bat (Myotis lucifugus) is a species of conservation concern due to its extreme susceptibility to white-nose syndrome (WNS). Low levels of the fungus causing this fatal disease have been detected in California, but we must understand localized temporal activity patterns of this species in order to provide efficient disease surveillance, population monitoring, and protection measures. With this study, we provide an example of year-round acoustic monitoring at an easily accessible site which informs both local management decisions and landscape-scale conservation efforts. We surveyed a known M. lucifugus maternity roost located in a historic district co-managed by the National Park Service and U.S. Fish & Wildlife Service as part of the Tule Lake National Monument. Year-round monitoring at this site allows for an informed management approach as conservation needs are balanced against site development for increased visitor access. Using acoustic detection, we documented seasonal activity patterns including arrival, departure, and pup volancy, as well as overall activity levels throughout the maternity season. These data will provide a baseline for monitoring behavioral changes potentially influenced by the arrival of WNS, increased visitor use, or changes in climate, all while minimizing disturbance and cost of long-term monitoring.

Ecology and Conservation of Bats

BAT USE OF CULVERTS

Jill M Carpenter; LSA Associates, Inc.; 20 Executive Park, Suite 200, Irvine, CA, 92614; (949) 337-6103; jill.carpenter@lsa.net;

Culverts are often mentioned along with bridges in the context of anthropogenic structures that provide bat roosting habitat; however, detailed information about bat roosts in culverts is difficult to find in the available literature despite the fact that these structures often have high conservation value to bats in certain landscapes and regions. Data collected throughout Southern California over a 13-year period show that many species of bats use a variety of culvert structures for roosting, including concrete box culverts, concrete pipe culverts, and corrugated metal pipe culverts. Bats have been documented day roosting (including maternity roosting), night roosting, and even mating within culvert structures. Day roost features often used by bats in culverts vary widely and can include overlap joints, expansion joints, manhole access shafts, open concrete surfaces, and bird nests. Misconceptions about what constitutes suitable roosting habitat for bats in culverts can result in these structures being overlooked during the environmental review process, and consequently impacts to bats roosting in culverts are often not mitigated. Because roosting habitat is a limited and declining resource for bats, overlooking culverts or less-commonly encountered features in culverts as roosts can have profound conservation and management implications. Successful strategies for mitigating impacts to bats in culverts will also be discussed.

Ecology and Conservation of Bats
CH-CH-CH CHANGE IS GOOD FOR YELLOW-BILLED CUCKOOS

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Ch-Ch-Ch Change is Good for Yellow-billed Cuckoos The western distinct population of the Yellow-billed Cuckoo (Coccyzus americanus) is most often associated in the literature with riparian habitat consisting of mature cottonwood (Populus spp.) and willow (Salix spp.). Prior to dam construction and other development, riparian forests within such a dynamic system as the lower Colorado River (LCR) would have been a mosaic of tree ages and sizes. These large, naturally established forests have disappeared on the LCR. In the mid-2000s the Lower Colorado River Multi-Species Conservation Program (LCR MSCP) began large-scale planting of cottonwood (P. fremontii), willow (S. gooddingii, S. exigua) and mesquite (Prosopis glandulosa), mainly through conversion of agricultural fields. Between 10-100 ha are planted each year at multiple sites. Cuckoos move into newly planted phases within the first 1-3 years after planting. As trees age, detections of cuckoos decline in the older stands and increase in more recent plantings. We encourage others to look at stand age and structure during surveys and monitoring of cuckoos. Understanding this relationship can guide habitat management in systems where flooding and scouring processes are absent.

PURPLE MARTINS NESTING IN SACRAMENTO: A LAST CHANCE AT CONSERVATION?

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The Purple Martin (Progne subis) has declined dramatically in California since the 1970s and is a state Species of Special Concern. The urban Sacramento population nests in overpasses and elevated freeways and is the last remnant of a widespread Central Valley population decimated by non-native European Starling (Sturnus vulgaris) competition. I have led a >20-year research and conservation program in Sacramento to assess population status, habitat requirements, human disturbance effects, and responses to management. Over 2004-19, the population declined 88% from 173 to 21 pairs. Most potential causes of decline, including competition, predation, disturbance, West Nile virus, vehicles collisions, and climate change have had minor or localized effects. Redevelopment and transportation projects have displaced pairs and caused nest failure. The only cause consistent with the widespread and substantial decline, however, is the effects of neonicotinoid pesticides. Using recent rates of decline, population extirpation is predicted in 5-30 years. I recently prepared a conservation strategy that emphasizes short-term management and protection for colonies from detrimental land uses, so that martins can survive if neonicotinoid use is eliminated or greatly reduced.

INFLUENCE OF BEAVER PRESENCE AND HABITAT MODIFICATION ON WILLOW FLYCATCHER OCCUPANCY IN THE SIERRA NEVADA
In the Sierra Nevada beavers have been theorized to modify meadows in ways that seem to increase habitat suitability for willow flycatchers, through maintaining surface water, encouraging wetland plant communities, preventing tree encroachment and discouraging nest predators. We developed a study to assess quantitatively whether the presence of willow flycatchers correlates with beaver presence and the intensity of their activity. In 2018 we quantified habitat attributes created and influenced by beavers in meadow stream reaches occupied (n=35) and unoccupied (n=32) by willow flycatchers, and built a resource selection function to test willow flycatcher selection for beaver-influenced habitat. We recorded characteristics of all beaver dams within sample reaches and characterized vegetation and water cover. We found that willow flycatchers were more than twice as likely to occupy a reach with 3 dams per hectare as a reach without beaver dams. Occupied reaches had 129% higher median willow cover and 143% higher median water cover than unoccupied reaches. Our findings have significant implications for the prioritization and design of meadow restoration projects and suggest that restoration practitioners, public land managers, and private land owners can improve willow flycatcher habitat by encouraging beavers and their activities, and potentially mimicking them, in montane meadows.

Ecology and Conservation of Birds I

FERAL HORSES DISRUPT GREATER SAGE-GROUSE LEKKING ACTIVITY IN THE GREAT BASIN

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Feral horse (Equus ferus caballus) populations in western North America now exceed three times the appropriate management level set by the Bureau of Land Management, while populations of sympatric greater sage-grouse (Centrocercus urophasianus) have declined concomitantly. Studies have reported the adverse impacts of feral horses on native ungulate species, but direct interactions between feral horses and sage-grouse are lacking. We utilized Bayesian multinomial logistic models to investigate the response of breeding male sage-grouse to the presence of native (i.e. mule deer, pronghorn) and non-native (i.e. cattle, feral horses) ungulates on active leks throughout Nevada during 2013-2019. We found sage-grouse were five times more likely to be on active leks concurrent with native ungulates relative to non-native ungulates. Furthermore, of the four ungulate species, sage-grouse were least likely to be at leks when feral horses were present. Our results suggest that feral horse presence negatively influences sage-grouse lekking activity. Sage-grouse population growth is sensitive to breeding success and disruption of leks by feral horses may reduce breeding opportunities. Additionally, feral horse management areas overlap with approximately 55% of core and priority sage-grouse areas within Nevada, increasing opportunities for interspecific conflict. Findings are preliminary and provided for timely best science.

Ecology and Conservation of Birds I

PARASITE PREVALENCE AND ITS EFFECT ON SONG

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Avian malaria prevails globally, affecting a large percentage of avian species. Behavioral changes in avian species affects reproductive, migratory, and survival patterns necessary for the species to persist. If it is found that parasitic infection results in reduced survival or altered behavior in indicator or endangered
species, it may be necessary to intervene to encourage species persistence and initiate conservation efforts. My objective is to analyze the songs of birds in San Francisco city parks as well as birds in rural habitat, and to test variance in song against parasite prevalence in individuals. We intend to focus mainly on haemoproteus, plasmodium, and leucocytozoon parasite species. I will also look at variables including regionality, temperature/climate, and distance to traffic. Assessing both parasite prevalence as well as human impact on bird song is important, birds rely on song for reproduction and for territory establishment. I hypothesize that high host burden will result in compromised song, assumedly impacting mating and territory rituals.

Ecology and Conservation of Birds I

HAEMOPROTEOSIS LETHALITY IN A WOODPECKER, WITH MOLECULAR AND MORPHOLOGICAL CHARACTERIZATION OF HAEMOPROTEUS VELANS (HAEMOSPORIDA, HAEMOPROTEIDAE)

Tierra C Groff; AECOM; 300 Lakeside Drive, Oakland, CA, 94612; (415) 342-1337; tierra.groff@aecom.com; Teresa J. Lorenz, Rocio Crespo, Tatjana Iezhova, Gediminas Valkiunas, Ravinder N.M. Sehgal

A juvenile white-headed woodpecker (Dryobates albolarvatus) fitted with a radio tag was located dead at approximately 22-days post-fledging in Yakima County in central Washington in July 2015. Postmortem examination revealed evidence of a haemosporidian infection that likely resulted in mortality. Subsequent trapping of local woodpecker species in the same area during the breeding season, June-July 2016 and May-July 2017, detected three adult northern flickers (Colaptes auratus) out of 139 live birds sampled infected with Haemoproteus parasites. Nested Polymerase Chain Reaction (PCR), sequencing, and microscopic analyses for avian haemosporidians revealed infections with Haemoproteus velans (Haemosporida, Haemoproteidae). This parasite was characterized molecularly and morphologically. This is the first report of a haemosporidian infection in a white-headed woodpecker anywhere in its range, and the first reported suspected mortality from haemoproteosis for a woodpecker (Piciformes, Picidae). The use of radio-tagged birds is an asset in wildlife haemosporidian studies because the effect of the pathogen can be monitored in real time. Additionally, this methodology provides opportunities to collect fresh material for microscopic and histological examination from wild birds that have died from natural causes.

Ecology and Conservation of Birds I
MAPPING THE BARRED OWL INVASION OF CALIFORNIA

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The listed threatened species Northern Spotted Owl (NSO) is negatively impacted by the recent arrival of the invasive Barred Owl (BDOW). Using GIS to map BDOW invasion over time could assist management efforts related to the invasion and could potentially help with planning in areas of the California Spotted Owl (CSO) where the range is more recently being impacted. I mapped the spread of the BDOW in California between 1978 and 2016 using a database of BDOW presence. The results revealed that BDOW spread increased significantly after 1999 and continues to grow. The mapping results revealed that the entire range of NSO is impacted by BDOW populations and the northern portion of CSO range is impacted. The areas in CSO range that are not impacted by the BDOW have been impacted by wildfires. I mapped wildfires between 1978 and 2017 that were within NSO and CSO range, and spatial patterns revealed a significant impact on NSO and CSO range. The impact from two threats, BDOW and wildfire, to CSO range and habitat could have negative impacts on the population and are an important consideration in the proposed federal listing under the endangered species act.

IDENTIFYING NORTHERN SPOTTED OWL INDIVIDUALS USING VOCALIZATIONS OBTAINED FROM AUTONOMOUS ACOUSTIC RECORDERS

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Current demographic studies for the threatened northern spotted owl (Strix occidentalis caurina) (NSO) rely heavily on detecting the species by its vocal responsiveness. However, research has shown a decrease in vocal responses due to the invasive barred owl (Strix varia) presence. Passive autonomous acoustic recorders may present a possible solution to this issue since they have been widely used in wildlife studies in addition to having documented the capability of identifying individuals based on vocal patterns. We aimed to determine if we could classify northern spotted owl recordings to the correct individual within the Hoopa Valley study area in Northern California from the 2016, 2017, and 2018 breeding seasons using nest site recordings from 18 males. We indexed frequency and duration measurements from 591 calls and ran a discriminant function analysis to classify calls to the individual. Single season results accurately classified 96.2% of calls for the 2016 breeding season, 99.3% for 2017, 88.4% for 2018, and 81.4% for three years combined. Results from this study suggest it is possible to identify NSO by their vocalizations although accuracy was found to vary depending on the number of individuals and recordings.

EXPERIMENTAL REMOVAL OF BARRED OWLS IN THE SIERRA NEVADA

Danny F Hofstadter; University of Wisconsin - Madison; 413 S Ingersoll St, Madison, WI, 53703; (812) 360-9492; dannyhof@gmail.com; Nicholas F. Kryshak, Brian P. Dotters, Kevin N. Roberts, Kevin G.
Invasive barred owls (*Strix varia*) represent a major threat to biodiversity in western North American forests, including the spotted owl (*Strix occidentalis*). This invasion has more recently expanded into California's Sierra Nevada and the California spotted owl subspecies (*S. o. occidentalis*) range. We used large-scale passive acoustic monitoring, broadcasted playback surveys, and recent and historic knowledge of barred owl territories to locate and lethally collect barred owls over a large portion of the region in conjunction with other biologists. Combined, 62 barred and barred-spotted hybrid owls were collected in 2019 across four national forests, Yosemite National Park, and private holdings. The primary studies associated with the barred owl collections are their population dynamics at the frontier of their range expansion, genetic kinship, diet analysis, and exposure to anticoagulant rodenticides. Our preliminary results of 1) barred owl detection and occupancy rates, 2) removal success and results, and 3) early spotted owl responses demonstrate that barred owl removal can be undertaken over a large area in a cost-effective manner with beneficial results. Despite the invasion pattern in the range of the northern spotted owl, our research demonstrates the potential for minimizing the invasion of barred owls into the Sierra Nevada ecosystem.

Ecology and Conservation of Birds II

**Student Paper**

**INTEGRATING GPS TAGGING AND NEST VIDEO MONITORING REVEAL NEW INSIGHTS INTO SPOTTED OWL FORAGING BEHAVIOR**

**Ceeanna J Zulla**; University of Wisconsin - Madison; 1630 Linden Drive, Madison, WI, 53706; (513) 675-1217; zulla@wisc.edu; John Keane, Kevin Roberts, Brian Dotters, Sarah Sawyer, R. J. Gutierrez, Sheila Whitmore, William Berigan, Kevin Kelly, Zach Peery

Identifying the habitat conditions that promote successful foraging by rare predator species is important for their conservation. However, distinguishing sites of successful prey captures from general locations using traditional telemetry methods does not allow identification of successful predation events. Thus, we integrated high-resolution GPS tagging data, nest video monitoring, and vegetation surveys to identify 1) foraging patterns, 2) predation events, 3) species captured, and 4) characteristics of successful California spotted owl (*Strix occidentalis occ.*) foraging sites. These elements allowed us to characterize fine-scale habitat conditions that mediate foraging success and prey selection. We also compared the habitats where owls successfully captured two primary prey species, dusky-footed woodrats (*Neotoma fuscipes*) and flying squirrels (*Glaucomys oregonensis*), and vegetation types available within the owls home range. Based on 5 GPS-tagged males and delivery of prey to nest sites, we confirmed the location of 54 prey capture events and identified the species of 36 captured prey. Preliminary analyses indicated that spotted owls tended to capture woodrats and flying squirrels in different vegetation types. These results complement existing information on spotted owl nesting and roosting requirements by providing an improved understanding of specific characteristics of foraging habitats that are correlated with successful prey captures.

Ecology and Conservation of Birds II

**Student Paper**

**DIET COMPOSITION OF BARRED OWLS (STRIX VARIA) IN THE PACIFIC NORTHWEST**

**Ryan C Baumbusch**; Oregon Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife, Oregon State University; 104 Nash Hall, Corvallis, OR, 97331; (760) 470-6716; ryan.baumbusch@oregonstate.edu; Katie M. Dugger, J. David Wiens

Barred owls (*Strix varia*) recently expanded their distribution across North America and their range now completely overlaps that of the federally threatened northern spotted owl (*Strix occidentalis caurina*).
Barred owls negatively influence northern spotted owl demographics through competition and competitive exclusion. To better understand the ecological impacts of barred owls beyond competition with spotted owls we investigated barred owl effects on the food web in Pacific Northwest forests by investigating diet composition of barred owls collected during a large-scale removal experiment. We analyzed the stomach contents of 1329 barred owls collected from 3 study areas in Washington and Oregon over 3 years and identified 4966 different prey items. We found that the broad diet of barred owls sampled varied considerably between the 3 study areas, with far more food items identified compared to diet studies that relied only on egested pellets. Preliminary results indicate that while small mammals still comprised a large portion of the diets in our collection localities, arthropods and salamanders were the dominant prey items found in 2 of our study areas.

Ecology and Conservation of Birds II  Student Paper
Ecology and Conservation of Mammals I

(sorted by presentation order)

LOCAL SCALE GENETIC STRUCTURE OF TULE ELK IN NORTHERN CALIFORNIA

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The tule elk (Cervus canadensis nannodes) - a unique subspecies of elk exclusive to California - was nearly driven to extinction in the late 19th century and subsequently experienced a severe genetic bottleneck and loss of genetic diversity. Currently tule elk are estimated to number near 6,000 animals across 22 herds. These herds exist in a metapopulation, a state that can lead to increased population structure and rapid loss of genetic variation if connectivity is not maintained by dispersing individuals. At the local scale, herds exist with varying degrees of connectivity and resultant genetic exchange. An imbalanced exchange of individuals at this level, among other factors, can lead to increased sub-structure and rapid loss of genetic diversity. Yet, herd connectivity and thus population structure at the local scale is not well understood. Understanding spatial structure at the local scale is useful for guiding management actions, including development of connective habitat and translocation efforts to maximize retention of genetic diversity. Here we investigate population structure of tule elk in Colusa and Lake Counties, CA using DNA extracted from hunter-harvested tissue, tissue from GPS-collared elk, and fecal pellets. Preliminary results suggest population structure exists both among and within the focal herds.

Ecology and Conservation of Mammals I Student Paper

PREDICTING PARTURITION: IDENTIFYING ELK CALVING EVENTS THROUGH MOVEMENT AND SPACE USE

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For wildlife managers, identification of ungulate parturition timing and location is necessary to protect crucial parturition habitat and can be used to calculate juvenile survival. Current methods for identifying partition events include neonatal capture and monitoring and visual analysis of location data, which are resource intensive and subject to biases. Recently, movement-based analyses using the spatial and temporal patterns contained in location data have shown promise for identifying parturition behavior; however, questions regarding efficacy and best practice have limited the adoption of such movement-based parturition models into management programs. To address these questions, we tested a set of movement and space use metrics to determine the best model for identifying parturition events in a population of Roosevelt elk. We used location data from cow elk with known parturition status and dates in order to establish probability thresholds and identify parturition events for elk with unknown parturition status. Our final model successfully distinguished all known parturition events as well as correctly identified parturition events which a visual assessment of points was unable to identify. Our results suggest movement-based parturition models are a reliable and cost-effective method that could augment or replace field-based and visual assessment techniques for identifying parturition events and recruitment rates.

Ecology and Conservation of Mammals I Student Paper
PLASTICITY IN MIGRATORY BEHAVIORS OF MALE BIGHORN SHEEP

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Migration is an evolutionary adaptation to seasonal environments that is functionally important to demography of populations, but relatively little is known about migratory behaviors of male ungulates. We classified migratory behaviors of male Sierra Nevada bighorn sheep (*Ovis canadensis sierrae*)—a federally endangered subspecies of bighorn sheep endemic to the Sierra Nevada of California—using migrateR and assessed relations between body fat and migratory behaviors. Migration (\( n = 154 \) animal-years) was 1.5 times as common as residency (\( n = 62 \)). Among \( n = 104 \) potential strategy-switching events (i.e., males tracked for 2 years or longer), \( n = 55 \) switches occurred. We did not detect a significant difference in body fat between migrants (18.4 +/- 0.8%; \( n = 44 \)) and residents (19.5 +/- 1.0%; \( n = 16 \)) or a relationship between autumn body fat and probability of migration, but the thinner an individual was, the further he migrated down the mountain. Our results indicate that migratory strategies of males were flexible and that there was an energetic underpinning for some migratory behaviors. Results from our work exemplify the importance of accounting for the unique physiology and behavior of male ungulates in their conservation and management.

Ecology and Conservation of Mammals I

AN EVALUATION OF THE EFFECTIVENESS OF MULTI-SOURCE TRANSLOCATIONS FOR MAINTAINING LEVELS OF GENETIC DIVERSITY IN REINTRODUCED HERDS OF DESERT BIGHORN SHEEP

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Translocations are used to reintroduce populations to previously occupied habitats and to augment existing populations, making them one of the most important tools for managing wildlife populations worldwide. One principle consideration when founding new populations is the resulting level of genetic diversity, as this is expected to be positively associated with long-term population persistence and health. Managers often use founders from more than one genetically differentiated source population in an effort to maximize genetic diversity, but it is unknown whether these individuals successfully hybridize in future generations for most systems. We evaluated the genetic consequences of six independent multi-source desert bighorn sheep reintroductions that were solely founded by individuals from two genetically differentiated source populations (Muddy and River Mountains, NV). Population level estimates of genetic diversity and individual ancestry classifications were generated based on ~10,000 SNPs sequenced across the genome using a genotyping-by-sequencing approach. Most individuals were classified as backcrosses instead of F2/F3 hybrids, suggesting that the two source ancestries did not fully recombine in these herds following translocation. Further, levels of genetic diversity were highly variable relative to those found in source populations, suggesting that multi-source translocations alone might not always be effective at maintaining diversity.

Ecology and Conservation of Mammals I

MULE DEER MIGRATIONS IN HIGHWAY UNDERPASSES

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Roadways pose a threat to migrations of mule deer (*Odocoileus hemionus*) in California. Three highway
underpasses were built in the 1970s along deer migration routes across highway 395 in Hallelujah Junction Wildlife Area (HJWA), Sierra County, California. Highway deer fencing was installed; however, it was not completed for the entire highway, and it has deteriorated allowing wildlife access to the highway. The California Department of Transportation will upgrade and extend the fencing in 2020. To understand underpass usage, we deployed two camera traps within each underpass. Data were collected June 2017-June 2019 with 4,282 mule deer detections. We also analyzed GPS collar data (from 2006-2015) of 26 mule deer in the area. More deer travelled through the underpasses during the spring (1,281-1,824) than the fall migrations (327-387). Eight of the eleven collared deer that crossed highway 395 likely used alternative (non-underpass) routes, and most crossings were south of the underpasses. This supports UC Davis Road Ecology's data (2019), which show wildlife-vehicle collisions south of the underpasses. Our results illustrate that while high amounts of deer utilize the underpasses, many likely use alternative routes. Our baseline data will allow us to investigate whether extended and upgraded deer fencing influences crossing behavior.

Ecology and Conservation of Mammals I

TRANSCRIPTOME-BASED ANALYSES AS AN IMPORTANT TOOL TO INFORM TRANSLOCATION MANAGEMENT OF BIGHORN SHEEP

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High-throughput sequencing technology enables managers to consider adaptive genetic variation in population management decisions. One such method, RNA-seq, can elucidate the relationship between gene regulation and phenotype, and thus gene pathways involved in response to the organism's local environment. Whether environmental adaptation is a fixed or plastic phenotype is invaluable to management actions such as translocation, upon which conservation of bighorn sheep (Ovis canadensis) is dependent. Given this species' distribution across broad elevational gradients from low desert to high montane regions, determining the extent to which animals may be successfully translocated between populations requires an understanding of genetic response to elevation. Our objective was to characterize gene pathways involved in the local adaptation of bighorn sheep to different elevational environments in California. We sequenced mRNA from desert bighorn sheep (Ovis canadensis nelsoni) endemic to one low-elevation (Mojave Desert) and one high-elevation (White Mountain) population, as well as from the Sierra Nevada high-elevation subspecies (Ovis canadensis sierrae). By conducting differential gene expression analysis and a transcriptomic scan for signatures of positive selection across lineages and elevations, we provide preliminary insights into the genetic underpinnings of high-elevation adaptation, and demonstrate the utility of RNA-seq in informing future management strategies for this species.

Ecology and Conservation of Mammals I
OCCUPANCY PATTERNS OF SIERRA NEVADA RED FOX AND THEIR COMPETITORS IN THE HIGH ALPINE OF YOSEMITE NATIONAL PARK

David Green; Institute for Natural Resources Oregon State University; Portland, OR, 97207; david.green@oregonstate.edu; Sean Matthews, Breeanne Jackson, Michael McDonald, Sarah Stock

Gaps in our understanding of the distribution and ecology of Sierra Nevada red fox (Vulpes vulpes nectaror) present challenges to critically evaluate threats to population persistence and implement empirically-supported conservation actions. Sierra Nevada red fox is the only native fox adapted and restricted to subalpine and alpine habitats of the Sierra Nevada and southern Cascade Mountains. Following an initial rediscovery of Sierra Nevada red fox in Yosemite National Park in 2014, park management has prioritized understanding how these foxes overlap and coexist with sympatric carnivores. Yosemite National Park biologists surveyed for Sierra Nevada red fox using standardized winter trail camera surveys in portions of the park above 8,000 feet since 2011. Using 9 years of detection/non-detection data, we explain the habitat associations and competitor relationships influencing the distribution of Sierra Nevada red fox in Yosemite National Park. Our results provide important insights that will inform future monitoring and conservation efforts for this rare carnivore species.

ASSESSING FOREST STRUCTURE, PREDATION RISK, DIET, ENERGETICS, AND MOVEMENT TO DEFINE COASTAL MARTEN HABITAT

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Defining habitat can be challenging, especially for rare and little-known species. Pacific martens (Martes caurina) are generally associated with mature forests. Small and isolated coastal populations of the Humboldt subspecies of Pacific martens (M.c. humboldtensis) occupy a diversity of vegetation types, including an Oregon population that occurs in a narrow coastal strip of ~70 year-old forested stands. We gathered information on distribution, resting and denning locations, forest structure, diet, occurrence of potential predators, movement, and energetics. We compared fine-scale vegetation characteristics with remotely sensed multi-scale predictive habitat models. We concluded no single variable strongly influenced predicted occurrence, but abiotic factors such as precipitation, fog, and distance from coast were influential variables in a range-wide model. Vegetation in near-coastal forests with dense shrub cover appears to provide, at least seasonally, fruit and increased prey. Predicted and realized energetic expenditures may ultimately serve as a basis for assessing predicted habitat, as tradeoffs likely explain marten distributions in unusual areas. Consistently being able to identify areas with sufficient resources for energetic stability, escape cover from predators, and a diversity of resting and denning locations, will be a productive undertaking for future work.

RESPONSE OF SAN JOAQUIN KIT FOXES TO THE TOPAZ SOLAR FARM: IMPLICATIONS
FOR CONSERVATION OF KIT FOXES

Brian L. Cypher; CSU-Stanislaus, Endangered Species Recovery Program; One University Circle, Turlock, CA, 95382; (661) 381-0048; bcypher@esrp.csustan.edu; Tory L. Westall, Kenneth A. Spencer, Daniel E. Meade, Erica C. Kelly, Jason Dart, Christine L. Van Horn Job

We conducted a 3-year investigation of the effects of the 1,421-ha Topaz Solar Farm (TSF) in central California on endangered San Joaquin kit foxes (Vulpes macrotis mutica). We compared various demographic and ecological attributes between the TSF and a nearby reference site. Survival was not different between sites and predators were the primary source of mortality on both. Reproductive success did not differ between the two sites. Home ranges were significantly larger on the TSF as were movements. Kit foxes on the reference site exhibited significant selection for untilled conserved lands while foxes on the TSF used most habitats in proportion to their availability. Den use patterns were not different between sites with number of dens used per year and rate of den switching both being similar. Food item use by foxes also was similar between the sites. We did not identify any differences in demographic and ecological attributes of kit foxes that indicated adverse impacts from the solar facility. Differences in some ecological attributes were largely a result of differences in habitat composition and associated food availability between the two sites. An important caveat is that use of the TSF by kit foxes was facilitated by numerous conservation measures.

Ecology and Conservation of Mammals II

ESTIMATING ENERGY EXPENDITURE BY FISHERS USING GPS TELEMETRY DATA

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Energy budgets provide insight into animals' food requirements under different environmental conditions. Direct measurement of energy expenditure is difficult, making indirect measurements important. In the past, Powell measured the metabolic rates of fishers (Pekania pennanti) running on a treadmill inside a metabolic chamber to complete a model for energy expenditure based on the time fishers spend resting and running. He then used field VHF telemetry and snow-tracking data in the model to estimate field energy expenditure of wild fishers. Telemetry using Global Positioning Systems (GPS) can provide data in all seasons that is far more extensive than, though not as precise as, snow-tracking and VHF telemetry. In autumns of 2012-2017, we outfitted 10 fishers (3F; 7M) in northern California, USA, with Lotek Minitrack (males) and Sirtrack Litetrack (females) GPS telemetry collars programmed to locate the fishers every 5 to 8 minutes. We followed the fishers for 4.5 +/- 2.9 days and collected 1800 +/- 2000 GPS locations per individual. We identified resting bouts from clusters of GPS locations within the distance of telemetry error. We used an equation developed from the data to estimate true distances travelled. Finally, we compared fisher energetics in 2 places with different terrain, climate and forests.

Ecology and Conservation of Mammals II

DOES NATURAL SELECTION AFFECT GENE FLOW BETWEEN NONNATIVE AND NATIVE RED FOX POPULATIONS?

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The Sacramento Valley red fox (SVRF, Vulpes vulpes patwin) is endemic to the northern Central Valley of California. It is considered a State Species of Greatest Conservation Need due to its decline in abundance from historical levels, low genetic effective population size, and restricted distribution. In contrast to its montane relatives, the SVRF occupies a semi-arid, lowland region, and is therefore predicted to have
unique evolutionary adaptations. Along with habitat loss, hybridization with nonnative red foxes of captive-bred origin has been identified as a threat to the SVRF. Continued genetic monitoring indicates low overall gene flow across a stable zone of hybridization. However, particular genes related to the unique evolutionary histories of the two populations (i.e. tameness, thermal tolerance, etc.) may be under positive or negative selection. Using a reduced representation, genotyping-by-sequencing (GBS) approach, we sequenced individuals from the native (n = 42), nonnative (n = 52), and hybrid (n = 18) ranges as well as from reference populations throughout North America (n = 170). We identified over 40,000 high-quality single nucleotide polymorphisms (SNPs) and detected multiple outliers within gene regions that may correspond to locally adapted elevational phenotypes as well as reproductive barriers between the SVRF and nonnative populations.

Ecology and Conservation of Mammals II

OTTER SPOTTER: COMMUNITY SCIENCE INITIATIVE INCREASES RIVER OTTER RANGE MAPS AND HIGHLIGHTS RIVER OTTERS ROLE IN WETLAND ECOLOGY

Megan Isadore; The River Otter Ecology Project; PO Box 103, Forest Knolls, CA, 94933; (415) 342-7956; megan@riverotterecology.org; Terence Carroll

The Nearctic river otter (*Lontra canadensis*) is an apex carnivore and sentinel for watershed health and environmental contamination. Historically extirpated from much of the San Francisco Bay Area, populations have been making an apparent recovery in the North, East and South Bay, yet agency data and range maps did not accurately represent the current extent of river otter range, and population monitoring was nonexistent. The River Otter Ecology Project launched a community science effort to solicit river otter sightings from the SF Bay Area and beyond during 2012 to the present. Our sighting questionnaire solicits structured data points, including date and time of sighting, location, habitat type, total number of otters observed, and other relevant information. In 2017 ROEP submitted our community science dataset to CDFW, and in 2019 CDFW updated their range map for river otters in California. The map update added 4,100 square miles to the river otter range. Our Otter Spotter program demonstrates the effectiveness of community science data in documenting landscape-scale changes in the presence of a recovering species. The importance of river otters as predators, their vulnerability to environmental contamination, their response to human alterations due to sea level rise, and their charisma make them important species for an understanding of conservation and wetland restoration.

Ecology and Conservation of Mammals II
Endangered Species: Planning for Recovery

THE CENTER FOR BIOLOGICAL DIVERSITY'S WORK TO PROTECT RARE AMPHIBIANS AND REPTILES IN THE WESTERN US

Jenny Loda; Center for Biological Diversity; 1212 Broadway, Ste 800, Oakland, CA, 94609; (510) 844-7136; jloda@biologicaldiversity.org;

The Center for Biological Diversity works to secure a future for all species, great and small, especially those hovering on the brink of extinction. The Center has a dedicated campaign focused on the protection of imperiled amphibians and reptiles and works to obtain federal and state safeguards and protected habitat for herpetofauna in the western US and across the country. The Center also works to insure compliance with the Endangered Species Act for species that are already listed under the ESA and uses advocacy at the local, state, and federal levels in its campaign to address the amphibian and reptile extinction crisis. In this presentation, Jenny discusses the Center's work to protect turtles, snakes, frogs, lizards and salamanders in the western US. These efforts include work to protect Shasta salamanders in California and dunes sagebrush lizards in Texas, challenging the expansion of an off-road vehicle park into an area rich with rare herps, advocating against trade in amphibians that may lead to the spread of disease, and litigating to insure public agencies are fulfilling their duties under the Endangered Species Act.

Endangered Species: Planning for Recovery

CALIFORNIA RED-LEGGED FROG RESPONSE TO POND RESTORATION

David L Riensche; East Bay Regional Park District; 2950 Peralta Oaks Court, Oakland, Ca, 94605; (510) 544-2319; driensche@ebparks.org; Connor D. Tutino, Leslie Koenig

The California Red-legged Frog (Rana draytonii) is federally listed as threatened. Habitat alteration is a significant contributing factor in their decline. Pond restoration and enhancement efforts are tools that can reverse this trend by improving habitat conditions that support recovery goals for the species. We removed excess sediment and emergent vegetation at the Garin Newt Pond Wildlife Area in central California to determine if these actions benefited this species. After sediment removal in 2017, the hydroperiod of the pond improved resulting in California Red-legged Frog egg masses and tadpoles increasing by 99% and 97%, respectively, compared to 2008-2016. We also found significant increases in number of adult and larvae sampled pre-restoration (2008 to 2017) and post-restoration (2018 to 2019). This new site-specific information on California Red-legged Frog response to pond hydroperiod improvements in a central California rangeland may assist recovery efforts designed to preserve and manage habitat for this threatened species. This presentation will also mention the increased regulatory environment, design requirements, and necessary heavy equipment operator skills necessary which are making pond maintenance increasingly more challenging and expensive to complete.

Endangered Species: Planning for Recovery

USE OF INTEGRATED POPULATION MODELS (IPMS) IMPROVES POPULATION ESTIMATES IN A SPECIES REINTRODUCTION PROJECT

Steven R Mathews; U.S. Geological Survey; Idaho State University; 800 Business Pk Dr, Suite D, Dixon,
Integrated population models (IPMs) implemented within a Bayesian framework allow for inclusion of disparate data and prior information within a single modeling environment to produce accurate parameter estimates. Historically, restoration of North American lekking grouse (*Tympanuchus* & *Centrocercus* spp.) via translocation has yielded poor results because translocated individuals exhibit demographic rates that are typically lower than residents in their source population. We reintroduced Columbian sharp-tailed grouse (*T. phasianellus columbianus*; CSTG) to Nevada, USA during 2013 - 2017 and used an IPM to model population dynamics. Initially, our model predicted population extirpation within five years of translocation, and model-predictions were misaligned with observed lek counts. We then utilized informative priors to estimate demographic contributions of non-monitored cohorts of native CSTG known to be present, and the model accurately predicted observed counts and population growth. The informative-IPM revealed an important demographic process that drives establishment of lekking grouse during reintroduction efforts, whereby non-monitored native individuals have demographic rates similar to source populations and recent translocated individuals did not. By accounting for demographic differences among cohorts, wildlife managers could more accurately evaluate future reintroductions and design techniques that facilitate immediate reproduction at release sites. Findings are preliminary and provided for timely best science.

*Endangered Species: Planning for Recovery*

**ASSESSING SPATIOTEMPORAL PATTERNS IN CALIFORNIA SPOTTED OWL VOCALIZATIONS WITH NOVEL ACOUSTIC TAGS**

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Occupancy-based studies of threatened species such as the California spotted owl often suffer from false detections of nonresident individuals, wherein an individual owl uses--and is subsequently detected in--multiple adjacent territories, thus upwardly biasing occupancy estimates. However, it is unknown whether these false detections also occur in passive acoustic monitoring (PAM) occupancy studies, which rely solely on the detection of four-note vocalizations. We addressed this knowledge gap by deploying novel acoustic tags that record simultaneous audio and GPS location data with high temporal resolution in order to study the spatiotemporal patterns of California spotted owl four-note vocalization. We manually reviewed audio data and delineated a "vocal home range," which defines the spatial extent over which owls broadcast four-note calls, for each individual. We also examined how factors such as sex, breeding status, time of night and time of year affect vocalizations. Our findings will allow us to improve PAM survey design, estimate rates of false detection, estimate territory size, and recommend overall improvements to monitoring strategies for this declining species. These results will have wide applicability to PAM studies of many other vocally active species around the world.

This paper is a work in progress.

*Endangered Species: Planning for Recovery*  
**Student Paper**

**LANDSCAPE AND MICROHABITAT MODELING INFORM CONSERVATION ACTIONS FOR THE ENDANGERED SAN BERNARDINO KANGAROO RAT**

**Rachel Y Chock:** San Diego Zoo Institute for Conservation Research; 15600 San Pasqual Valley Road, Escondido, CA, 92027-7000; (650) 576-4095; rchock@sandiegozoo.org; Sarah McCullough Hennessy, Thea B. Wang, Emily Gray, Debra M. Shier
The San Bernardino kangaroo rat (*Dipodomys merriami parvus*, SBKR) is endemic to southern California and has lost more than 95% of its historic habitat. Despite being a federally listed endangered species since 1998, SBKR continues to face many anthropogenic threats, including development and the resulting flood control and fire suppression. With the loss of contiguous habitat and natural disturbance, it is critical to prioritize areas for conservation and improve suitability of remaining habitat patches. Utilizing 16 years of survey data, we created a range-wide species distribution model which revealed that alluvial scrub cover and fluvent soils were strongly associated with SBKR occupancy of a landscape. Through microhabitat surveys we identified non-native grass cover, shrub cover, bare ground and sandy soils as features related to SBKR abundance, and calculated the optimal range of cover for each habitat type. Together, the pair of models identifies areas to prioritize for conservation or restoration, and provides target values for habitat enhancement. In order to recover many species impacted by rapid urban expansion, coordinated and strategic conservation and restoration efforts are necessary to facilitate population growth and expansion.

*Endangered Species: Planning for Recovery*

**INFLUENCES ON FORAGING PREFERENCES OF THE ENDANGERED PACIFIC POCKET MOUSE (*PEROGNATHUS LONGIMEMBRIS PACIFICUS*): IMPLICATIONS FOR A NOVEL CONSERVATION STRATEGY**

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One approach to combating the threat of invasive species replacing the native food sources of captive-bred endangered animals from conservation breeding and reintroduction programs is to expand the foraging options of these animals to include palatable invasive species. Utilizing the conservation breeding program for the endangered Pacific Pocket Mouse (*Perognathus longimembris pacificus*, PPM), we experimentally determined how seed origin, exposure during crucial developmental periods, and nutritional quality influence PPM's willingness to consume invasive food types. Preferences were tested using the Cafeteria Method design and nutritional characteristics were determined with near infrared-reflectance spectroscopy. Captive-born PPM preferred commercial seeds, which contain higher levels of moisture and starch, to native and invasive seeds. However, exposure to invasive seeds during pre-weaning increased PPM's willingness to forage for invasive seeds. This study, the first of its kind, has the potential to improve PPM reintroduction efforts and provides insights to other management programs facing similar concerns.

*Endangered Species: Planning for Recovery*
Habitat Restoration and Multi-Benefit Projects

(sorted by presentation order)

BEACH STONE LAKES MITIGATION MULTI-BENEFIT WOODLAND CORRIDOR: BALANCING FLOOD RISK REDUCTION WITH ECOLOGICAL VALUE

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In 2019, Sacramento Area Flood Control Agency (SAFCA) began work at the Beach-Stone Lakes Mitigation Site, a multi-benefit project balancing ecological restoration, active agriculture, and flood risk reduction. Woodland corridors, located south of Sacramento on two sites, will provide compensatory mitigation for vegetation and high-hazard tree removal associated with a portion of SAFCA’s Levee Accreditation Program. Once plantings have reached target heights and densities, the woodland corridors will help protect the adjacent Beach Lake Levee from wind driven wave energy by reducing wave height during flood events. The woodland corridors will augment important nesting habitat for neotropical migratory birds and special-status raptor species, including Swainson's hawk. SAFCA has worked diligently with the property owners, Sacramento Regional County Sanitation District (SRCSD) and Sacramento Area Sewer District, to obtain easement rights and identify site improvements to enhance the agricultural and ecological value of the land. Designing, planning and achieving this multi-benefit project has been a careful balance of competing interests and limited resources. This presentation will identify and describe the various factors driving site design to ultimately provide wildlife habitat value and reduce flood risk and explain how project objectives were balanced to achieve success.

Habitat Restoration and Multi-Benefit Projects

BARK BEETLE, WHITEBARK PINE REMOVAL, AND A RECREATION LEGACY

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This projects goal is to utilize ecological forestry techniques to enhance socio-ecological resiliency and protect important ecosystems and rural livelihoods from potential catastrophic and devastating wildfire. This project uses a phased approach to: 1) reduce potential wildfire severity within whitebark and lodgepole pine mountain pine beetle-killed forest; 2) promote regrowth of a proposed Threatened conifer species; 3) enhance conifer-encroached mountain meadows and quaking aspen stands; and, 4) support the wildlife species which depend on this high elevation keystone forest, including the Clark's Nutcracker. By protecting an at-risk keystone ecosystem within the June Mountain Ski Area, this project simultaneously benefits fish and wildlife while also protecting residences, June Lake villages legacy of outdoor recreation-based economy, drinking-water supplies, and major third party communications facilities. The presentation will share successes and lessons learned by a unique federal government-corporate-non-profit partnership from Phase I of the project. Several relevant policy-related components will be discussed including challenges with land management restrictions, landscape-level restoration of historic fire regimes, and protection of the Wildlife-Urban Interface (WUI) zones of the Eastern Sierra Nevada.

Habitat Restoration and Multi-Benefit Projects
THE SCIENCE OF RECLAIMING PUBLIC LAND CANNABIS CULTIVATION SITES: A PROCESS-BASED EVALUATION OF RECLAMATION EFFORTS TO MAXIMIZE WILDLIFE AND ECOSYSTEM BENEFITS

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Research highlighting negative impacts to wildlife and human health associated with illegal trespass cannabis cultivation on public lands has expanded considerably within the last decade. Currently, a backlog of several thousand historic cultivation sites exist on public lands within California alone, which continue to contaminate foodwebs and degrade natural functioning of ecosystems. Removing these threats presents a unique challenge due to the complexity of utilizing law enforcement sensitive data while operating within remote forests with the potential presence of dangerous pesticides. We will present the development of innovative approaches to site risk characterization, data management workflows, personnel safety protocols, and multi-agency partnerships, all of which are necessary to implement safe and effective removal of grow site infrastructure through reclamation activities, thus enhancing wildlife habitat. This study represents the first in-depth analysis of over 300 independent site reclamations to identify required resources, optimal post-eradication timing, uncommon challenges, and weaknesses within current funding structures limiting reclamation efforts on a state-wide scale. Our findings support the need for an organized network of reclamation collaborators operating statewide implementing reclamation efforts within a limited time window post-eradication to minimize required resources and maximize wildlife and ecosystem benefits.

Habitat Restoration and Multi-Benefit Projects

CREATING LARGE OXBOW PONDS PARALLEL TO A CALIFORNIA COASTAL STREAM TO CREATE CALIFORNIA RED-LEGGED FROG BREEDING HABITAT: LESSONS LEARNED

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Loss of natural breeding habitat is the primary threat to the California red-legged frog, Rana draytonii. Cotoni-Coast Dairies National Monument (CCDNM), on the coast of the San Francisco Peninsula, is in the portfolio of Federally-managed habitat for R. draytonii and represents a conservation opportunity. The coastal estuaries on the property have been historically degraded to create passage for a railroad and Highway One, and consequently the sole breeding habitat for R. draytonii at CCDNM is in artificial ponds, many of which are failing. US Bureau of Land Management, PG&E, the Santa Cruz Resource Conservation District and the US Fish & Wildlife Service formed a partnership to create very large shallow pools parallel to Yellowbank Creek, one of six major creeks on CCDNM. Approximately $75,000 was budgeted for construction, which took 2 weeks to complete. Ponds immediately filled with ground water, which created challenges for heavy excavation equipment. However, the final ponds filled successfully and remained filled through the subsequent 15 month monitoring period. In the summer of 2019, adult Rana draytonii colonized the ponds, creating potential for the ponds to serve as breeding habitat in the spring of 2019.

Habitat Restoration and Multi-Benefit Projects

WHERE WILL ALL THE TURTLES GO? WESTERN POND TURTLE MOVEMENT AND HABITAT USE IN SUISUN MARSH

Melissa K Riley; California Department of Fish and Wildlife and UC Davis; 2825 Cordelia Road, Suite 100, Fairfield, CA, 94534; (209) 628-0247; Melissa.Riley@wildlife.ca.gov;
The Western Pond Turtle (*Actinemys marmorata*) - California's only native freshwater turtle - is a species of special concern, in California. In other parts of its range like Washington, *A. marmorata* is listed as endangered primarily due to habitat loss and disease. In the Suisun Marsh, observational data has shown that *A. marmorata* is widespread, but little is known about their population status and habitat requirements. Suisun Marsh consists of a mosaic of tidal and managed brackish water wetlands, with 5,000 - 7,000 acres of tidal restoration planned within the next 30 years. However, it is unknown how *A. marmorata* will respond as the implementation of tidal restoration policies leads to the conversion of managed marshes to fully tidal habitat. The objective of this study was to track the movement and habitat use of *A. marmorata* using mark-recapture and GPS/GSM tracking technology in order to understand how impending changes in Suisun Marsh will affect *A. marmorata*. Preliminary results show that populations are large and healthy. In addition, *A. marmorata* is using a variety of aquatic and terrestrial habitats within tidal and managed wetlands such as muted tidal ditches, ponds, mud banks, and levees. Insights gained from this project will aide future conservation efforts.

*Habitat Restoration and Multi-Benefit Projects*
SPATIOTEMPORAL OVERLAP AND PARTITIONING OF MAMMALIAN MESOPREDATORS ACROSS AN URBANIZATION GRADIENT IN CALIFORNIA'S CENTRAL VALLEY.

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As Californian communities rapidly expand and become more urbanized, wildlife that live at the periphery of these urban edges may experience increased conflict with humans, domestic animals, and other species. Species may spatiotemporally partition to mitigate conflict, however, increased urbanization may increase overlap of species with similar ecological needs. I sought to investigate whether spatiotemporal overlap would increase for one such group, mammalian mesopredators, across an urban gradient in California's Central Valley. Using 30 baited camera traps at 111 camera sites, I captured thousands of photos of coyotes (Canis latrans), opossums (Didelphis virginiana), raccoons (Procyon lotor), striped skunk (Mephitis mephitis), and domestic cats (Felis catus) from May to August 2019. Preliminary results will be presented on the spatiotemporal patterns of these species. To investigate temporal overlap, I compared the activity patterns of species at different strata of urbanization using kernel density analysis in the overlap package in R. To investigate spatial overlap of species, I used a single species occupancy model framework to investigate species use of a 1km2 sample area compared to several urban covariates (buildings, population density, and imperviousness). Further steps include using conditional two-species occupancy modeling to investigate whether species are conditionally co-occurring at camera sites.

WHAT MAKES AN URBAN BEAR URBAN?

Mario J Klip; California Department if Fish and Wildlife; 1701 Nimbus Road, Rancho Cordova, CA, 95670; 530257582; mario.klip@wildlife.ca.gov;

Development and encroachment into wild habitats often create a wildland-urban interface. Urban wildlife involved in conflict sometimes may be considered to have a lesser ecological value than its wild counterparts. Despite its ubiquitous use, the term "urban" was not homogenous throughout the scientific literature and needed to be defined. Spatially defined urban extents have great influence on whether wildlife is deemed urban or not. From 2010-2014, I outfitted 27 bears with GPS Iridium radio collars in Lake Tahoe to understand spatial usage. I assessed existing urban definitions and tried to define the most conservative definition that would include human development in the broadest sense. I assessed whether bears were spending 50% or more of their time in urban areas, if they did I considered them urban. During 2010-2011 no bears spent >=50% of their time in urban areas; during 2012 25% of the bears spent >=50% of their time in urban areas, whereas during 2013, 2014 and 2015 half of the bears spent >=50% or more of their time in urban areas. While bears appeared to prefer urban habitats at first order (defined as the study area), they generally did not select urban habitats within their home range (second order).
REGULATING CANNABIS CULTIVATION: RECENT OBSERVATIONS FROM AN ENVIRONMENTAL COMPLIANCE PERSPECTIVE

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Following the legalization of adult recreational use of marijuana in California in 2016, local governments (i.e., cities and counties) may not prohibit adults from growing, using, or transporting marijuana for personal use. Permitting of commercial cannabis operations in California is currently handled by California Department of Food and Agriculture (through the CalCannabis Cultivation Licensing Program), the Bureau of Cannabis Control, and California Department of Public Health. In addition, some municipalities have moved to regulate commercial activities within their jurisdictions. Several counties have prepared Cannabis Cultivation Ordinances, which are then subject to environmental review under the California Environmental Quality Act. In addition, the State Water Quality Control Board issued a general order for water quality protections and California Department of Fish and Wildlife has specific application procedures for Lake and Streambed Alteration Agreements for cannabis cultivation projects. This presentation will discuss some approaches to regulatory compliance and mitigation measures to protect sensitive species and habitats, the challenges of defining "baseline" conditions in light of illegal grows, and how federal regulations relate to state and local regulations.

Human Dimensions in Wildlife Conservation and Management I

IMPACTS OF TRESPASS CANNABIS CULTIVATION ON PUBLIC LANDS TO SMALL MAMMAL POPULATIONS

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Trespass cannabis cultivation on public lands is a continuing concern throughout California. The associated environmental impacts and degradation to the surrounding ecosystem and its wildlife, including species of conservation concern, is significant. Mortality due to pesticides used at cultivation sites is commonly observed in several forest carnivore, raptor, and prey species. Small mammals intentionally poisoned by cultivators to prevent them from harming growing cannabis plants and their own food stores may become contaminated prey for predatory species such as fishers and northern spotted owls. In 2014, we began investigating how rodenticides used to control small mammals at trespass cultivation sites affect the local prey population. To date, we have monitored small mammals at 15 cultivation site - control pairs with all species of rodents targeted. We are evaluating any effects associated with these sites on the abundance, diversity, and physiology of rodents. In addition, we test all incidental mortalities from trapping efforts for pesticides. Preliminary results demonstrate that cultivation sites are significantly more likely to have contaminated prey than control sites. This study is ongoing and will continue into 2021 to investigate the longevity of these effects after cultivators abandon the sites.

Human Dimensions in Wildlife Conservation and Management I

IT'S A TRAP! CANNABIS CULTIVATION SITES AS ECOLOGICAL AND EVOLUTIONARY TRAPS FOR WILDLIFE

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Ecological and evolutionary traps can pose unforeseen risks to wildlife by allowing disadvantageous environments to mimic optimal habitat or trigger behavioral choices that diminish an individual's
reproductive success or chance of survival. Illegal and unregulated cannabis cultivation on Western forest lands has emerged significantly over a very short period of time with rapid anthropogenic alteration of the environment to create ideal cultivation conditions. This swift uptick in landscape modification associated with attractants such as food trash, poison baits, and aromatic chemicals, coupled with deleterious cultivation practices from black-market cultivators, may be both ecological and evolutionary traps for terrestrial and avian wildlife. We will discuss these trap potentials using a unique California state-wide data set for which we monitored wildlife at numerous landscape features associated with cannabis cultivation over a period of six years. We have observed that pesticide contamination on soil, water, cannabis and native plants coupled with habitat manipulation and anthropogenic wildlife attractants acting in concert can create ecological or evolutionary traps for wildlife. As a remedy to the problems generated by these traps, we will discuss an experimental framework through which we attempt to rectify these maladaptive cues and monitor the responses from wildlife most affected by them.

*Human Dimensions in Wildlife Conservation and Management I*

**COEXISTING WITH CANNABIS: WILDLIFE RESPONSE TO MARIJUANA CULTIVATION**

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Many states in the Western US are now engaged in a large-scale policy experiment with the decriminalization of recreational cannabis, leading to increases in rural agricultural development. As cannabis transitions to mainly private land cultivation, the environmental outcomes of this policy change are largely unknown. To understand wildlife response to cultivation on private land, we used motion sensitive camera traps on and surrounding seven cannabis production sites in Southern Oregon from 2018-2019 to detect the presence of medium to large mammals. We compared species composition and occupancy on and surrounding production sites, and found species-specific responses to cultivation, with some animals attracted to production sites and others deterred. There were wild animals present at all production sites, though sites with fences seemed to limit the body size of the species present. These results emphasize the need to work with private landowners and cultivators to encourage sustainable land use practices and coexistence with wildlife as cannabis cultivation continues to increase in rural, biodiverse areas.

*Human Dimensions in Wildlife Conservation and Management I*  
*Student Paper*
EFFECTS OF WIND TURBINE CURTAILMENT ON BIRD AND BAT FATALITIES

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As bird and bat fatalities increased with wind energy expansion, the only effective fatality-reduction measure has been operational curtailment documented for bats but not for birds. We performed opportune before-after, control-impact (BACI) experiments of curtailment effects on bird and bat fatalities and nocturnal passage rates during fall migration at two wind projects, where one continued operating and the other shut down from peak migration to study's end. We also performed BACI experiments of curtailment and operational effects on bird fatalities among wind turbines of varying operational status and which we monitored for three years. Wind turbine curtailment reduced rates of passages and fatalities of bats, but not of birds. Converting wind turbines from inoperable to operable status failed to significantly increase bird fatalities. In one study, birds averaged 43% more fatalities/MW/year at inoperable than at operable turbines, and species of cavity-nesters and cavity-roosters also died in substantial numbers at vacant towers. Of bird species represented by fatalities, 79% were at inoperable wind turbines. Because the migration season is relatively brief, seasonal curtailment would greatly reduce bat fatalities for slight loss of annual energy generation, but it might not benefit many bird species.

THE CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE'S WILDLIFE INCIDENT REPORTING SYSTEM: EFFORTS TO EVALUATE REPORTING BEHAVIORS

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California is the nation's most populous state with more than 39 million people. Continued development and growth in human population especially in rural areas calls for a statewide wildlife conflicts tracking program. Thus, the online statewide Wildlife Incident Reporting System (WIR) provides insights to the frequency, types, and public perception towards human-wildlife interactions and conflicts. The primary objective of this study was to better understand voluntary reporting behaviors. The WIR black bear reporting data was coded then analyzed to identify common causes of conflict across the incident reports. A second objective was to evaluate the correlation between prior measures taken (e.g. hazing) and other variables. For coding the reports, a thematic coding guide was developed and then used to code all reports of black bear incidents in the WIR from 2009 to 2019. Afterwards, regression and non-linear regression models were used to determine whether county level census data could explain variance in the data. Overall, this human dimension research helps with 1) recognizing the human-wildlife conflicts the general public faces, 2) in determining wildlife management and education focus, and 3) Identifying patterns and general trends of reported human-wildlife conflict as part of conflict management for government agencies. References: https://conbio.onlinelibrary.wiley.com/doi/full/10.1046/j.1523-1739.2003.01458.x https://www.lincolninst.edu/publications/articles/urban-development-options-californias-central-valley
EFFECTS OF DROUGHT ON REPORTED INCIDENTS OF HUMAN-WILDLIFE CONFLICT IN CALIFORNIA

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Previous research indicates that human-wildlife conflicts (HWCs) are exacerbated during periods of drought. The California Department of Fish and Wildlife (CDFW) used records of HWC to evaluate this hypothesis in California. All HWC incidents requiring response by CDFW staff were recorded between July 2016 and June 2017. This period coincided with a shift from several drought years to a wet winter. CDFW tracked the incidents in the statewide online Wildlife Incident Reporting system to analyze the effects of drought on HWC. Month and precipitation by county, as compared to its 30-year average annual precipitation levels, were used to test associations between seasonality and annual precipitation changes. Seasonality was observed to play a large part in HWC dynamics. After controlling for seasonality, CDFW found drought responses for certain species, but not for black bears, mountain lions, or deer. For coyotes, bobcats, foxes, and raccoons, the odds of conflict increased by 1-2% for every 25 mm (~1 inch) decrease in precipitation. These findings suggest that mesocarnivores in California may experience increased human-wildlife interactions during drought because they are displaced away from water sources and prey by more dominant competitors. These findings are the results of early exploration of CDFW human-wildlife incident data.

Human Dimensions in Wildlife Conservation and Management II

AIMING FOR PERTINENT CONSERVATION IMPACTS: STRATEGIC PLANNING AND DECISION-MAKING THROUGH STANDARDIZATION AND DATA-DRIVEN ANALYSES

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The State of California has engaged in ecosystem conservation for over three decades, during which time many programs, plans, and analytical tools were created to help facilitate these efforts. Some have employed standardization and a priori data-driven analyses to create frameworks that allow for learning-based actions and adaptive management. They aim for improved transparency and for pertinent actions to deliver intended results, reflecting the dynamic natures of ecosystems and human interests, while at the same time sustaining overall ecological health and socio-economic activities. During this talk, Junko will illustrate a few of these approaches and methodologies sharing recent accomplishments and challenges encountered through the following efforts: California State Wildlife Action Plan 2015 Update, a regional-based conservation framework that provides a vision and blueprint for actions to sustain the state's ecosystems. The SB34 Advance Mitigation Land Acquisition Grants Program, an in-lieu fee grant program that is designed to strategically purchase parcels in advance of development, while providing an option to mitigate project impacts by purchasing mitigation credits for multiple species and habitat type(s) in the California deserts.

Human Dimensions in Wildlife Conservation and Management II

WASTEWATER TREATMENT PLANTS AND ENDANGERED & THREATENED WILDLIFE SPECIES OVERLAP IN CALIFORNIA WATERSHEDS

Anna Cassady; UC Riverside; Dudek; 3544 University Ave, Riverside, CA, 92501; (805) 540-8015;
Years of drought coupled with the expansion of urban centers in California have resulted in more municipalities disposing treated wastewater, or effluent, into urban freshwater streams. Freshwater streams are important for nutrient cycling, sediment transport, habitat for native species, and other ecosystem functions. With changing climates, increases in human population growth, and fluctuations in water demand, water management techniques such as effluent recycling have become a common strategy employed by municipalities to satisfy the multitude of water resource needs. Many wastewater treatment plants release a flow of effluent throughout the year that is inconsistent with the seasonal variability in which some natural floodplains may rely. One result of this is the potential re-configuration of floodplain habitats and the potential displacement of native species that rely on the different components. Through this lens we evaluate the impact of effluent on biodiversity within California, with a particular emphasis on federally and state-listed threatened and endangered species.

*Human Dimensions in Wildlife Conservation and Management II*  
*Student Paper*
Impacts to Lands and Wildlife from Recreation

(sorted by presentation order)

BALANCING CONSERVATION AND RECREATION - TRAILS ON CONSERVATION LANDS

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Conservation and mitigation efforts in California often result in the establishment of conservation and mitigation lands dedicated to the protection of species and their habitats. These lands are typically managed by open space districts, local parks departments, land trusts, federal or state agencies, and others. Recreationists often see these lands as valuable for recreation, especially due to their open space or pristine qualities. Conversely, land managers often struggle to protect the conservation values of the land from being lost or adversely affected by recreation uses or from being "loved to death". This presentation will explore how trails and recreation activities on conservation land, when allowed, can be planned and managed appropriately to complement, rather than diminish, the conservation values. The session will include a brief overview of management challenges and success stories. It will focus on lessons learned, advice on how to address this issue, tools available to determine the types and extent of recreation access that should be allowed, and potential ways the conservation and recreation interests can work together to achieve future land use planning for both interests.

Impacts to Lands and Wildlife from Recreation

KILLER POTATO CHIPS - CHANGING VISITOR BEHAVIOR TO CONSERVE AN ENDANGERED OLD GROWTH FOREST NESTING SEABIRD AT REDWOOD NATIONAL AND STATE PARKS, CALIFORNIA

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Adaptive management informed by biological and sociological research and monitoring is being utilized to conserve the endangered marbled murrelet (Brachyramphus marmoratus). Monitoring using nest cameras has revealed high rates of murrelet nest predation by Steller's jays (Cyanocitta stelleri). Other research indicated elevated jay densities occur near campgrounds and picnic areas because of supplemental food supplied by park visitors. Natural resource managers worked with interpretation staff to develop educational materials and programs that explained the importance of marbled murrelets, threats of predation from jays, and how people could help by keeping a clean campsite. To measure the effectiveness of the strategy, the presence of Steller's jays near campgrounds, picnic areas, and control areas have been monitored. Early results indicated no change in jay densities in campgrounds and alternate approaches were sought. As a result natural resource managers adopted a new successful strategy using targeted human behavior change messaging based on sociological research conducted at the park. Key concepts learned: remove behavioral barriers, don't bury the lead message, tell people exactly what you want them to do with non-passive language, model the behavior you want to see, and make your messages and graphics consistent, short and ubiquitous at key visitor "choke-points".

Impacts to Lands and Wildlife from Recreation

BIG WALL BATS
Yosemite climbers frequently encounter roosting bats. However, park managers know little about how climbers may be impacting bats, or if climbers may be a vector for spreading Pseudogymoascus destructans, the fungus causing white-nose syndrome (WNS). Since WNS was first documented in eastern North America in 2006, more than 5.7 million bats have died and entire roost colonies have been wiped out. Recent detections of WNS in California underscore the potential for WNS to travel great distances in little time—potentially through human vectors. The vertical cliffs of Yosemite, such as El Capitan, are known for world class climbing, yet virtually nothing is known about the 17 bat species (including 5 California species of concern and 6 species susceptible to WNS) that roost upon them. Scientists have identified cavers as having spread Pd between caves and disturbing bats but whether and to what extent climbers play a role is yet unknown. Big Wall Bats is a collaborative effort between biologists and climbing rangers at Yosemite National Park to engage climbers in bat conservation and describe how bats use the high cliffs in Yosemite to roost and hibernate. We will report successes and lessons learned from our first-year of surveys and community science engagement.

**Impacts to Lands and Wildlife from Recreation**

**FACTORS INFLUENCING THE ABUNDANCE OF WINTERING WESTERN SNOWY PLOVERS AT CROWN BEACH STATE MEMORIAL PARK**

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Shorebird populations are declining worldwide. Survival during the nonbreeding season, when mortality from food shortages and raptor predation is likely highest, can shape wintering shorebird habitat use patterns and population growth. The Western Snowy Plover (*Charadrius alexandrinus nivosus*) is a small shorebird that is listed as a federally threatened species and as a California Species of Special Concern. Previous studies suggest that humans, dogs, crows, and other birds are the main sources of annoyance to plovers on public beaches. For over six years, we observed plover behavior and their responses to these disturbance factors at Crown Beach State Memorial Park in Alameda, California. From 2014 to the present, the wintering population of Western Snowy Plovers at this site has increased from six to over 54 individuals, after the establishment of the Plover Protection Zone (PPZ) and the volunteer "Plover Protection Patrol". Habitat choice and prey availability are vital to wintering Western Snowy Plovers. We also examined the potential prey abundance within the PPZ, and in the areas directly north and south. Results showed that macro-invertebrate prey availability is greater in the PPZ and may be another important factor affecting wintering Western Snowy Plover at this metropolitan beach.

**Impacts to Lands and Wildlife from Recreation**

**SEA THE VALUE: ECONOMICS OF WILDLIFE ECOTOURISM IN LA JOLLA COVE**

Lily M Olmo; University of North Carolina at Chapel Hill; 329 Amaryllis Way, Wake Forest, NC, 27587; (614) 313-0278; lilyolmo@yahoo.com; Jeffrey A. Seminoff

Wildlife ecotourism is a popular industry around the globe, particularly in protected areas. This non-consumptive use of wildlife contributes to ecosystem conservation, while allowing communities to leverage the economic value of their resources. Despite the recent growth of ecotourism, the direct economic benefits are not often studied. Here we analyze the economic benefits of wildlife ecotourism at a popular tourist destination, La Jolla Cove, within a southern California ecological reserve. Interviews were
conducted with residents, tourists, and local business owners to analyze the frequency and economic value of guided wildlife tourism in the area. The contingent valuation method (CVM) was utilized to measure the average willingness of visitors to pay for guided wildlife tours. The average visitor is willing to pay $58.50 for a guided wildlife tour, whereas visitors interested in specific species are willing to pay an average of $95.11 per tour. Overall, survey data show that guided wildlife tours generate an annual revenue of at least $20.1 million for local ecotourism operations. This study is the first economic analysis of ecotourism in La Jolla, and can be continued to assess changing markets. This information could enhance future ecotourism operations and provide economic incentive for the conservation of wildlife.

*Impacts to Lands and Wildlife from Recreation*  

*Student Paper*
Mitigation Measures and Conservation Planning: Ways to Measure Success

( sorted by presentation order )

AREAS OF CONSERVATION EMPHASIS (ACE). UNDERSTANDING THE DISTRIBUTION OF BIODIVERSITY IN CALIFORNIA.

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Areas of Conservation Emphasis (ACE) is an effort by the CDFW Conservation Analysis Unit to understand how biological resources are distributed across the state and provide stakeholders with an easy-to-use map interface reflecting multiple facets of biodiversity to inform conservation planning. Information on Species Richness, Significant Habitats, Connectivity, and Climate Resilience is available through a series of ACE map layers in various levels of detail. Users may click an ACE map unit--hexagon or watershed, to access a table of species observed or modeled. At a coarser scale, ACE indices tell a story of relative biodiversity levels across the landscape. Species distribution models and observation data are aggregated and summarized to produce native, rare, and rarity-weighted (Irreplaceability) species richness scores for each hexagon and watershed. These scores are further generalized into an overall Biodiversity score for each map unit. For users requiring greater detail, a series of maps is available portraying scores for each constituent taxa--amphibians, birds, reptiles, mammals, fish and plants--for each of the richness metrics. Information-rich ACE maps are organized in a hierarchical manner in the web-based ACE-Viewer so conservation practitioners may choose the category of information and level of detail that best suits their needs.

Mitigation Measures and Conservation Planning: Ways to Measure Success

MODELING THE MANAGEMENT OF NON-NATIVE GAME MAMMALS TO REDUCE FUTURE CONFLICTS WITH NATIVE PLANT CONSERVATION IN HAWAII

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Introduced ungulates cause agricultural damage and degradation of native biodiversity throughout Hawaiian ecosystems. These ungulates include feral livestock which have been successfully managed and eradicated on many other oceanic islands, but also more recently introduced wild species which are more difficult to control. The Hawaii Interagency Biosecurity Plan has identified ungulate control as the single most expensive invasive species problem in the state, largely because of costly barriers necessary to separate areas managed for sustained-yield hunting from those where ungulates are eradicated. Large numbers of wild and feral ungulate species have been removed from Maui, Lanai, and Molokai during recent years, partly under marketing initiatives, but substantial population reductions have not yet occurred. Long-term solutions that are being considered to reduce annual management costs will include land use prioritization modeling with stakeholders to protect native threatened and endangered species from extinction, minimize ingress, and to facilitate both population control and sustained-yield hunting. Population modeling would also inform seasonal and daily bag limits to manage for desired levels of abundance; selective removals of females could be particularly effective for reducing adult sex ratio bias and population growth rates similar to programs used in other states to manage overabundant deer.

Mitigation Measures and Conservation Planning: Ways to Measure Success
SCIENCE TO INFORM A TIERED MANAGEMENT APPROACH TO REDUCE RAVEN IMPACTS ON GREATER SAGE-GROUSE

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Common raven (Corvus corax) populations have increased dramatically in recent decades, primarily resulting from landscape alterations and anthropogenic resource subsidies. Despite growing evidence of ravens adversely impacting numerous sensitive species, repeatable strategies for raven assessments and management approaches are lacking. We provide scientific basis for a multi-tier management approach using a rapid survey and ecological thresholds that might help direct research needs and guide management actions for ameliorating impacts of ravens on sensitive prey species. We use greater sage-grouse (Centrocercus urophasianus) as an example prey species given their priority in state and federal land management plans. Our approach engages three tiers of management actions: (1) improvement to sage-grouse habitat that reduces probability of predation by ravens; (2) reduction of access to anthropogenic resource subsidies that provide alternative food sources (e.g., roadkill, landfills) and perching and nesting substrates (e.g., power lines); and (3) lethal techniques at various life stages (e.g., egg-oiling techniques, application of DRC-1339). We demonstrate the use of multiple quantitative tools that guide the assignment of tiers and facilitates movement among tiers based on key post-management raven assessments. This preliminary information is subject to revision. It is provided for timely best science and should not be cited as conclusive.

Mitigation Measures and Conservation Planning: Ways to Measure Success

CONSERVATION OF SAN JOAQUIN ANTELOPE SQUIRRELS: ECOLOGICAL ASSOCIATIONS, HABITAT SUITABILITY, AND CONSERVATION STRATEGIES

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San Joaquin antelope squirrels (Ammospermophilus nelsoni: SJAS) once were widely distributed in arid shrubland and grassland habitats in the western and southern portions of the San Joaquin Valley, CA. Conversion of natural lands to agricultural, urban, and industrial uses has substantially reduced the available habitat for SJAS. The remaining distribution and optimal habitat conditions for this species are not well known. We conducted surveys for SJAS at 326 locations during 2017-2019 using automated cameras, collected habitat attribute data at each location, and used the results to produce a habitat suitability model. Locations where SJAS were detected were typically in arid shrub scrub or grasslands with sparse ground cover and flat to moderate terrain. Model results estimated 5,931 km2 of high or moderately-high suitability habitat still present within the historical range and an additional 4,753 km2 of moderately-low or low quality habitat. Recommendations resulting from this project are (1) conduct additional SJAS surveys, (2) conserve remaining highly suitable habitat, (3) manage vegetation to reduce ground cover and enhance suitability, (4) research effective translocation strategies, (5) translocate SJAS to unoccupied sites with suitable habitat, and (6) develop strategies for restoring disturbed lands to make them suitable for SJAS.

Mitigation Measures and Conservation Planning: Ways to Measure Success

BAT MITIGATION STRUCTURES ON BRIDGES AND CULVERTS IN CALIFORNIA
Transportation structures provide important resources for bats, but activities associated with their improvement or replacement can put bat populations at risk. During the summers of 2017 and 2018 we surveyed 61 bridges and culverts throughout California to evaluate bat mitigation. Of those surveyed, 39 bridges and culverts were evaluated for their effectiveness at mitigating impacts on bats and their roosting habitat. The examined mitigation projects included situations where the original habitat was left intact, the original habitat was lost and new on-site habitat was provided, and the original habitat was lost and new off-site habitat was provided. We also measured the efficacy of using add-on structures such as Oregon-wedge bat boxes, steel bat boxes, open-top bat boxes, and cast-in-place roosting habitat. We used acoustic surveys, exit counts, and day roost counts to measure success. Cast in place crevice habitat was the most successful followed by on-site Oregon wedge-style bat boxes. Open-topped bat boxes worked in regions with warm summer nights but not in regions along the coast where summer nights were cool. Off-site bat boxes were almost never occupied by bats. Bat mitigation is complex and a thorough understanding of bats' natural history is needed for the best results.

San Joaquin kit fox (SJKF) are present at the 1,680-acre California Flats solar facility in southern Monterey County, California. Pre-construction surveys for SJKF began in late 2015, and continued throughout construction from 2016 to 2019. All observations of SJKF individuals and dens were recorded via GPS, and active dens were monitored via remote motion-activated cameras. In order to avoid impacts to SJKF, all active dens were buffered from project activities, and natal dens located in proximity to roads or construction activities were also monitored by biologists. The number of SJKF individuals, active dens, and natal dens increased after construction began, especially in the southwest area of the project. The success of SJKF at California Flats demonstrates that implementation of avoidance and minimization measures can allow rare species to persist in the midst of large-scale renewable energy projects.

Mitigation Measures and Conservation Planning: Ways to Measure Success

San Joaquin Kit Fox Presence at a Large-Scale Solar Facility in Monterey County

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Mitigation Measures and Conservation Planning: Ways to Measure Success
Decades of fire suppression and the effects of climate change have created a wildfire crisis in California. Since 2010, the number and acreage of wildfires has increased annually, including recent catastrophic wind driven fires. The CalVTP is one tool intended to help implement Governor Brown's Executive Order B-52-18 mandating an increase in the pace and scale of fire fuel treatment programs to reduce wildfire risk. The CalVTP would treat approximately 250,000 acres annually of nonfederal land to reduce risk of life and property loss, protect natural resources, and establish more natural fire regimes. Vegetation treatment activities under the CalVTP include manual and mechanical treatment, prescribed burning and herbivory, and herbicides. The CalVTP Program EIR provides CEQA streamlining for CAL FIRE and other state or local agencies seeking to implement vegetation treatments. The streamlined approach would document a project's environmental effects and which resource protection measures from the Program EIR would be incorporated to avoid and reduce effects, including on wildlife and habitat. Mechanisms to expedite other regulatory approvals, such as for projects that may affect listed species or are located within the coastal zone, should also be considered to facilitate the increase in pace and scale of vegetation treatments.

SPECIES-SPECIFIC IMPACT MITIGATION FOR THE CALIFORNIA VEGETATION TREATMENT PROGRAM

The California Vegetation Treatment Program (CalVTP) directs implementation of vegetation treatments within the State Responsibility Area to reduce wildfire risks and minimize the harmful effects of wildfire on people, property, and natural resources in California. CAL FIRE is the primary agency responsible for implementing CalVTP. CalVTP incorporates various activities including mechanical or manual treatments, prescribed burning, herbivory, and herbicide application, which have potential to adversely affect wildlife. The type and magnitude of impacts on wildlife depend on various factors including the treatment activities implemented, species affected, time of year, and location. Due to the geographic scope of CalVTP (approximately 20 million acres), nearly 350 special-status wildlife species were considered when evaluating impacts of CalVTP implementation. Resources were characterized according to ecoregion, and species were organized into functional groups based on life history for impact evaluation. Developing feasible mitigation posed unique challenges for some species groups, including rare, elusive invertebrates; endangered bighorn sheep populations; and endangered species with extremely specific habitat requirements. Careful consideration of impacts at the species, habitat, landscape, and treatment levels is critical to avoiding or minimizing impacts to wildlife while also prioritizing CAL FIRE's mission of serving and safeguarding people and protecting property and resources of California.
DELIVERING ON-THE-GROUND CONSERVATION IMPACTS VIA STATE WILDLIFE ACTION PLANS - A NEXUS FOR INTEGRATED ECOSYSTEM MANAGEMENT

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State Wildlife Action Plan (SWAP) 2015 Update is a CDFW publication developed to frame the conservation priorities of the state, identifying actions necessary to sustain the state's ecosystems. During the past 8 years through its planning and implementation, CDFW learned many lessons, such as recognizing a fundamental lack of operational structure and understanding the need of such to support integrating diverse conservation and management efforts. Conservation communities are in general in accord with strategic, integrated, and collaborative approach; however, we often struggle to walk the talk due to various obstacles stemming from the gaps, including outdated regulatory, financial, and governance structures, or human-dimensional conflicts, such as resistance/inertia fighting for resources, ownership or leadership. CDFW has embarked on tackling such challenges. During the talk, the latest on integration efforts in the context of SWAP implementation will be discussed. Junko will introduce an experimental project to implement SWAP through exploring operational models addressed under the SWAP's auxiliary plans. Creating SWAP is actually part of a larger nationwide effort to conserve at risk species before it becomes too difficult and costly. Counterpart efforts to leverage resources to implement SWAPs, through Recovering American's Wildlife Act, will be also discussed as a national integration example.

Public Policy and Wildlife Management

TRENDS IN HUNTING AND FISHING LICENSE SALES AND THEIR IMPLICATIONS FOR CALIFORNIA'S RECRUITMENT, RETENTION, AND REACTIVATION PROGRAM

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The decline in participation in hunting and fishing presents a challenge to wildlife management. Hunting and fishing not only funds wildlife conservation through license revenue and sales tax but it is also an important management tool for maintaining certain species at desirable population levels as well as being an important cultural tradition. Many states are engaging in "R3"efforts to "recruit" new hunters and anglers, "retain" existing hunters and anglers, and "reactivate" lapsed hunters and anglers. While often combined into a single program, each one of the "R's" is a separate objective that is focused on a different audience. Examining past license sales can shed light on who has purchased licenses in the past and who has stopped purchasing licenses. California, as the most populous state, presents an excellent case study for R3 research. Here we look at the purchasing behavior for different licenses, tags, validations, and report cards in California to see how well an individual's past license purchasing influences whether they purchase licenses in the future. We then use this model to analyze trends across the state and across different types of licenses, tags and report cards and discuss how these patterns can guide R3 efforts.

Public Policy and Wildlife Management

THE CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE AND COMMERCIAL CANNABIS CULTIVATION: HOW WE PROTECT FISH AND WILDLIFE RESOURCES IN A GROWING CANNABIS INDUSTRY

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The California Department of Fish and Wildlife (CDFW) has a unique role in how California permits commercial cannabis cultivation. This role enables the protection of fish and wildlife resources from potential impacts such as pollution from pesticides and fertilizers, dewatered streams from diversions, migration barriers and sedimentation from stream crossings, site development impacts from habitat loss and fragmentation, and site use impacts that include road use, noise, and artificial light. California's Business and Professions Code specifies that a commercial cannabis cultivation license from the California Department of Food and Agriculture (CDFA) is not effective until the applicant has complied with a CDFW permitting requirement relating to lake or streambed alterations. CDFA regulations require applicants to provide a CDFW Lake and Streambed Alteration Agreement or written verification that one is not required. CDFW's Lake and Streambed Alteration (LSA) Program is responsible for permitting projects that would substantially alter any river, stream, or lake (e.g., by way of water diversions, stream crossings, etc.) and that may substantially adversely affect an existing fish or wildlife resource. An LSA Agreement includes measures necessary to protect fish and wildlife resources. Additionally, Business and Professions Code gives CDFW the authority to add any conditions deemed necessary to protect fish and wildlife directly into the commercial cultivation license. CDFW currently has teams from our Wildlife and Fisheries Branches working on developing a statewide monitoring program for wildlife that may be impacted by cannabis cultivation. The results from this monitoring may provide valuable insight into measures we include in our permits for cannabis cultivators. CDFW's role in commercial cannabis cultivation is an excellent example of how science can be used to influence policy and permitting decisions while protecting fish and wildlife resources.

Public Policy and Wildlife Management

ECOLOGICAL MONITORING INFORMS ADAPTIVE MANAGEMENT OF CALIFORNIA'S PRIVATE RANGELANDS AND APPLICATION OF CONSERVATION PROGRAMS

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Privately owned rangelands in California provide critical habitat for a multitude of wildlife species. These same lands are under significant threat from conversion and development. Point Blue Conservation Science Partner Biologists work in Natural Resources Conservation Service field offices across California, providing value-added capacity to local conservation efforts. Partner biologists monitor birds, vegetation, and soils across private rangelands in 24 counties. These data are primarily used to help advance private lands adaptive management by serving as ecological baselines, informing management recommendations, and tracking response to management practices through time. Bird data collected from private lands also informs our understanding of populations and can be used to update focal species target numbers in guiding documents (i.e. Central Valley Joint Venture, California Partners in Flight). Soil carbon data also informs baselines conditions across California rangelands. These documents provide a critical link between science and habitat management. Partner Biologists and NRCS Conservation Planners can use these quantified population and habitat objectives to help prioritize restoration and enhancement projects which can benefit from USDA Farm Bill programs, CDFA Healthy Soil programs, and other sources of conservation dollars.

Public Policy and Wildlife Management
Wildlife and Climate Change

A HABITAT SUITABILITY MODEL FOR IDENTIFYING WILLOW FLYCATCHER HABITAT REFUGIA IN A CHANGING CLIMATE

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Wet meadows make up a small fraction of the landscape in California's Sierra Nevada but are used by the majority of avian species during some portion of their life cycle. Many species, including Willow Flycatcher (Empidonax traillii) are entirely dependent on them. Willow Flycatcher numbers in the Sierra Nevada have declined substantially since the early 20th century, primarily due to habitat degradation. We used machine learning techniques and existing data on climate, habitat, and Willow Flycatcher occupancy to determine the characteristics that best predict Willow Flycatcher presence in the Sierra Nevada. We then modeled the effect of future climate change scenarios on meadows and their predicted impact on Willow Flycatcher occupancy. Our models suggest that favorable conditions for Willow Flycatchers will be less common, and increased temperatures and reduced snowpack are projected to result in most previously favorable meadows becoming unsuitable by 2070. Identifying and protecting habitat at individual meadows that have the capacity to serve as climate change refugia for Willow Flycatchers may be essential to prevent total loss of this species in the Sierra Nevada, and similar methods will be able to help identify refugia for other meadow specialists.

Wildlife and Climate Change

ASSESSING MESOCARNIVORE RESPONSE TO SEVERE DROUGHT THROUGH LONG-TERM POPULATION MONITORING

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From 2012-2015 California experienced an extreme drought, unprecedented in severity and duration in the last ~10,000 years. This represents a major disturbance event with the potential to profoundly affect biological communities. In this study we assessed the effects of climactic and vegetation change over a 14 year period encompassing this drought (2002-2015) on four mesocarnivore species in the southern Sierra Nevada Mountains that exhibit a variety of competitive interactions due to similarities in body size, diet, and habitat requirements; fisher (Pekania pennanti), Pacific marten (Martes caurina), ringtail (Bassariscus astutus), and gray fox (Urocyon cinereoargenteus). We analyzed detection information from a long-term carnivore monitoring network across ~12,000 km2. Data was collected at repeated visits within and across years at fixed arrays of track plates, remote sensor cameras, and hair snares resulting in ~36,500 visits over the 14 year monitoring period. We used dynamic occupancy models to investigate how changes in climate and vegetation influenced detectability, site occupancy, colonization, and persistence for each species over time. This long-term data set provides a unique opportunity to investigate the effects of climate and vegetation change on a mesocarnivore guild at a landscape scale.

Wildlife and Climate Change

RAPID AND VARIED RESPONSES OF SONGBIRDS TO CLIMATE CHANGE IN CALIFORNIA
CONIFEROUS FORESTS

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The global climate is changing faster than previously anticipated. Although scientists expect cumulatively deleterious impacts to birds and other wildlife, effects on individual species are likely more complex. The California Department of Fish and Wildlife has monitored > 100 songbirds across 37,600 km² of Northern California conifer forests for close to two decades to facilitate informed, science-based conservation planning. The study area represents 42% of all conifer forests in the state. Autonomous sound recorders were used to survey birds at 1,065 randomly distributed sites from 2002–2016. The richness of Neotropical migrants declined below 1,515 m (90%CI: 1,150–1,950 m) elevation whereas it increased above this threshold after controlling for changes in tree cover due to forestry and wildfire. This finding suggests an overall upward shift in Neotropical migrant distributions in response to an annual 0.037°C (90% CI: 0.029–0.045°C) increase in mean daily May temperature during the timespan. Residents and altitudinal migrants may be less vulnerable to increasing temperatures, conversely, as evidence of elevational shifting was much weaker or non-existent for them. Yet for individual species, there were both declines and increases in occupancy. Rapid and mixed population trends, in combination with elevational range shifts, suggest that songbirds vary widely in their capacity to adapt to climate change and other stressors. Conservation of structurally-complex and fire resilient forests above ~1,500 m elevation is paramount in helping to buffer songbirds against rising temperatures. The expansion of biodiversity monitoring across large taxonomic, spatial, and temporal extents is vital to effective conservation planning.

Wildlife and Climate Change

BREEDING VARIABILITY OF THE SIERRA NEWT (TARICA SIERRAE) IN AN INTERMITTENT CENTRAL CALIFORNIA FOOTHILL STREAM: RESULTS OF A LONG-TERM STUDY BEFORE AND AFTER DROUGHT

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Very few studies have been conducted on the Sierra newt (Taricha sierrae), a species that is distributed throughout the western slope of the Sierra Nevada. During late winter and early spring, the Sierra newt congregates in intermittent streams to breed. During the 1998-1999 breeding seasons, T. sierrae instream movement and distribution were studied in a segment of the south fork of Little Dry Creek, located on the McKenzie Preserve in eastern Fresno County. In this study, T. sierrae individuals (marked by tattoo) exhibited high site fidelity within stream subareas, but there were several individuals that moved extensive distances, particularly after storm events. In 2004-2010 and within this same population and stream segment, a total of 634 newts were marked with PIT tags. Starting in 2004, this stream segment was then surveyed for newts bimonthly or weekly during each breeding season through the 2018/2019 breeding season. During the 2011-2017 drought years, little breeding occurred, and in one year no breeding was observed. Numbers of individuals observed in this stream segment post drought have not yet reached those observed before the drought; however, several individuals marked with PIT tags prior to the drought continue to be detected during the breeding season.

Wildlife and Climate Change

INFLUENCE OF WATER TEMPERATURE ON TWO SPECIES OF FAIRY SHRIMP IN SOUTHERN CALIFORNIA VERNAL POOLS
Water conditions influence the presence and timing of emergence of fairy shrimp in vernal pools. Previous studies suggest that water temperature determines which species appear during the inundation period and their hatch rate and timing. Although some information is available from ex-situ (laboratory) studies on the relationship between water temperature and "days to hatch" ('Days to Hatch at Temperature', D-H-T) for some fairy shrimp species, it is unknown how this is related to field conditions in southern California vernal pools. Precipitation timing coupled with diurnal temperature variations affect vernal pool temperatures, thus the D-H-T can be variable. In 2011, 2017 and 2019, underwater temperature data loggers were placed in vernal pools within one week of inundation on two preserves in southern California, simultaneous with conducting normal wet season monitoring for fairy shrimp. Results fluctuated across years and in each pool for two species of federally listed fairy shrimp: Riverside fairy shrimp (Streptocephalus woottoni) and vernal pool fairy shrimp (Branchinecta lynchi). These two species, previously reported as found in the same vernal pools but not swimming together, have now been found in some years to have an overlapping D-H-T. Climate change could affect this dynamic and further threaten both species.

Wildlife and Climate Change

POPULATION GENETICS OF AN AMERICAN PIKA HYBRID ZONE IN ROCKY MOUNTAIN NATIONAL PARK, CO

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In a rapidly changing environment, increasing genetic variation should increase evolutionary potential, particularly for small, isolated populations. However, the introduction of new alleles, either through natural or human-mediated processes, may have unpredictable consequences. We identified a contact zone and limited gene flow between historically separated genetic lineages of American pikas (Ochotona princeps), representing the northern and southern Rocky Mountain subspecies, within Rocky Mountain National Park. The limited spatial extent of gene flow observed may be the result of geographic barriers to dispersal, selection against hybrid individuals, or both. Our fine-scale population genetic analysis suggests gene flow is limited but not completely obstructed by extreme topography such as glacial valleys, as well as streams including the Colorado River. The discovery of two subspecies within this single protected area has implications for monitoring and management, particularly in the light of recent analyses suggesting that the pikas in this park are vulnerable to fragmentation and local extinction under future projected climate change. Future research will investigate potential reproductive barriers, as well as the fitness consequences of introgression among distinct genetic lineages.

Wildlife and Climate Change
**RETROSPECTIVE ASSESSMENT OF FUEL BREAK EFFECTIVENESS FOR CONTAINING RANGELAND WILDFIRES WITHIN THE GREAT BASIN**

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Iconic sagebrush ecosystems of the American West are threatened by an accelerated cycle of wildfire and annual grass invasion that destroys thousands of hectares of sagebrush annually. Rangeland and wildlife managers are challenged with finding methods to effectively thwart this novel disturbance regime, and increasingly look toward networks of fuel breaks as a management tool. Fuel breaks may minimize catastrophic losses of sagebrush by reducing hazardous fuel loads, disrupting fuel continuity, and facilitating staging of initial attack and suppression operations, but an extensive evaluation of effectiveness at broad spatiotemporal scales is lacking. Thus, we leveraged extensive multi-agency databases of fuel breaks coupled with annual wildfire severity and extent maps in a retrospective analysis to identify conditions related to fuel break effectiveness across the Great Basin. On their own, fuel breaks do little to halt wildfires, yet we describe a suite of environmental variables and fuel-break design characteristics associated with increased probabilities of halting the spread of wildfire. Results can also help managers identify other areas for targeted fuel break installations and associated tradeoffs between fire suppression and sagebrush disturbance produced by fuel break installation and maintenance. Findings are preliminary and provided for timely best science.

**BLACK-BACKED WOODPECKER OCCUPANCY IN BURNED AND BEETLE-KILLED FORESTS: DISTURBANCE AGENT MATTERS**

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In the western United States, the black-backed woodpecker (*Picoides arcticus*) is a "snag specialist", occurring predominantly in burned montane forests. Recently, unprecedented large tracts of drought-stressed forest in California have succumbed to bark beetle outbreaks. We tested for differences in black-backed woodpecker occupancy between fire- and beetle-killed forests, and whether key environmental relationships driving woodpecker occupancy differed between stands affected by the two disturbance agents. Between 2016 and 2018, we surveyed for black-backed woodpeckers during 4,448 surveys at 75 burned and 113 beetle-killed forest stands throughout the black-backed woodpecker's California range, detecting at least one black-backed woodpecker on 448 surveys in burned forests and 115 surveys in beetle-killed forests. Occupancy declined with time-since disturbance in fire-killed but not beetle-killed forests, but occupancy increased similarly with snag density resulting from both disturbance agents. Across our broad study region, black-backed woodpeckers were more likely to occur in burned forests at higher latitudes and elevations; these patterns were even stronger in beetle-killed forests. Our results demonstrate that for this disturbed-habitat specialist, disturbance agent matters.
ELEVATIONAL GRADIENTS STRONGLY MEDIATE HABITAT SELECTION PATTERNS IN A NOCTURNAL PREDATOR

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Mountain ecosystems contain strong gradients in climate and vegetation as a function of elevation. Consequently, habitat selection by animals may vary across broad elevational ranges. We characterized nocturnal habitat selection by GPS-tagged California spotted owls (*Strix occidentalis occidentalis*) along a 1000-m elevational gradient in the Sierra Nevada, California. We derived a suite of stand- and fine-scale forest structure metrics from high-resolution light detection and ranging (LiDAR) data for mixed-effects resource- and step-selection functions. We found that the directionality and magnitude of nocturnal habitat selection varied as a function of elevation: at lower elevations, owls selected stands with shorter trees and sites closer to edges with less forest type diversity and more ridge and southwest aspect. At lower elevation and fine spatial scales, owls selected areas with less canopy cover in their core home range and fewer tall trees outside of their core. Higher elevations showed the opposite. Prey selection may explain these results: owls consume more woodrats (earlier successional species) at lower elevations and more flying squirrels (older forest species) at higher elevations. Thus, managing for increased woodrat habitat at low elevations (though not in suitable owl nesting areas), and flying squirrel habitat at higher elevations, could benefit owls.

SHIFTING MANAGEMENT PARADIGMS: CONSERVING FUNCTIONAL FISHER HABITAT IN THE NEW SIERRA NEVADA

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Since 2007, extensive research on fisher ecology, behavior, and habitat in California's Sierra Nevada region has been ongoing. In 2016, this research led to the release of a comprehensive, multi-agency conservation strategy aimed at conserving habitat and maintaining population viability. One key information gap identified was the need for recommendations on how to increase fisher habitat resilience in the face of shifting disturbances regimes; a need emphasized by ecological change that manifested as the strategy was completed. Coinciding with the strategy's release, the landscape shifted dramatically with extensive drought and beetle infestation leading to a massive die-off of conifer species and a large-scale loss of the fisher habitat. Updated habitat modelling suggests that the underlying framework of habitat availability has changed, going from a relatively continuous band of habitat along the western slope of the Sierras to a highly fragmented metapopulation relying on tenuous corridors. Management objectives have shifted accordingly, moving from a focus on retaining large blocks of high quality habitat to: 1) identifying and stabilizing remaining habitat; 2) restoring landscape permeability; and 3) promoting heterogeneity and resilience. We discuss how Sierra Nevada fisher habitat has changed over the past 5 years and how management is attempting to respond.
EXPLORING THE DEN CLUSTER CONCEPT: INSIGHTS FROM FISHER (*PEKANIA PENNANTI*) REPRODUCTIVE ECOLOGY AND IMPLICATIONS FOR MANAGEMENT

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Maintaining habitat that can support reproduction of rare species can be challenging, particularly with wildlife that are elusive and difficult to track to active reproductive sites. The fisher is a species of conservation concern in the southern Sierra Nevada that uses large diameter trees with cavities to raise young. Females typically use multiple den structures in a single reproductive season and reproductive dens can only be reliably located using radio-telemetry on females fit with transmitters. In areas where active dens are not being located via telemetry, forest managers need additional tools to maintain potential denning habitat. Previous research efforts have identified characteristics of individual trees used by females for denning, but less attention has been given to describing the habitat patch which contains all dens used by a female in a single season - the "den cluster". We propose that the den cluster concept could be used to help identify forest patches of suitable size within which a connected network of potential den trees could be maintained. We explore attributes of fisher den clusters documented over a decade in the Sierra National Forest, consider how unique aspects of fisher ecology may influence their placement, and discuss implications for forest management.

*Wildlife and Forest Management and Policy*

PLANT SELECTION BY BUMBLE BEES IN MONTANE RIPARIAN HABITAT OF CALIFORNIA

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Many bumble bee species have declined dramatically across North America and the globe, highlighting the need for a greater understanding of the habitat required to sustain or recover populations. Understanding bumble bee plant selection is important for promoting valuable plant resources that will help populations persist. We sampled 413 plots within riparian habitat in the Sierra Nevada of California for bumble bees during two summers following extremely low and normal precipitation years, respectively. We assessed the five most abundant bumble bee species' plant selection by comparing their floral use to availability. Bumble bee species richness was constant between years (13 species) but abundance nearly tripled from 2015 to 2016 (from 1243 to 3612 captures), largely contributed to by a dramatic increase in *Bombus vosnesenskii*. We captured bumble bees on over 105 plant species, but only 14 of them were significantly selected by at least one bumble bee species. The bumble bee species considered each selected their own distinct set of plant species. Plant blooming phenology, availability of flowers, and plant selection remained fairly constant between the two study years, suggesting that maintaining, seeding, or planting with these "bumble bee plants" may benefit a broad suite of bumble bees across years.

*Wildlife and Forest Management and Policy*
SIERRA NEVADA RED FOX CAPTURES IN THE LASSEN PEAK REGION CONTINUE TO REVEAL NEW INFORMATION ON DENNING ECOLOGY, HABITAT USE, AND INBREEDING

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During the second year of a three-year project, we continue to learn more about the ecology of the Sierra Nevada red fox (Vulpes vulpes necator) in the vicinity of Lassen Volcanic National Park (LVNP). Using a combination of satellite tracking collars, baited camera stations, and collection of non-invasive samples, we identified a minimum of 11 individuals during the 2017-2018 season. During the 2018-2019 season, one male and two females were re-captured (collared in 2018), and fitted with new satellite tracking collars, after their collars failed prematurely. A third female was also captured just outside of the Caribou Wilderness area. Two of the collared foxes became a mated pair and produced at least two pups at a den that was discovered near Lassen Peak. Previous genetic analyses indicate that the pair are siblings, which represents the second inbreeding event we have documented during this study. Despite three of the four collars failing prematurely again, and one collar that was retrieved from the field from a female fox with an unknown fate, we will present data on home range estimates, denning ecology, and some interesting new information on diet.

GENOMIC CONSEQUENCES OF INBREEDING AND ADMIXTURE IN THE SIERRA NEVADA RED FOX

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In the last century, the Sierra Nevada red fox subspecies (Vulpes vulpes necator) has declined precipitously throughout its historical range. Today it occurs in three regions: the Cascade Range in Oregon, the Lassen Peak area in northern California, and the central Sierra Nevada in California. Despite a shared ancestry, the three populations have undertaken independent demographic trajectories since their isolation, with each region experiencing different intensities of inbreeding and degrees of isolation. Here we used a combination of high-coverage and low-coverage whole genome resequencing to characterize the recent demographic histories of extant Sierra Nevada red fox populations. We used runs of homozygosity (ROHs) to identify segments of chromosomes identical-by-descent, and compared the distribution of ROHs within and between populations to make inferences about the timing and severity of past inbreeding. We discuss our results in the context of future management options for Sierra Nevada red fox, as well as make a case for the broader utility of genome-wide analyses to inform conservation strategies of small and isolated populations.

Wildlife Conservation and Habitat Management in Lassen / Shasta Landscapes
The Revised Recovery Plan for the Northern Spotted Owl (NSO) was signed on June 28, 2011 and includes 33 Recovery Actions. Several of these Recovery Actions are specifically applicable to dry, interior forests in northern California. Recovery Actions 10, 11, and 32 describe forest management to restore or maintain NSO habitat. Recovery Action 12 is aimed at understanding NSO habitat relationships in post-fire landscapes and limiting adverse effects of post-fire forest management. Several Recovery Actions emphasize developing collaborative partnerships to promote conservation and recovery of NSO. This presentation will discuss and describe updated information regarding successes as well as opportunities for improvement in implementing the NSO Revised Recovery Plan.
Wildlife Diseases and Pathology

(sorted by presentation order)

ADDRESSING THE THREAT OF WHITE-NOSE SYNDROME IN BATS: PREPARATION FOR AND INITIAL RESPONSES TO THE DETECTION OF PSEUDOGYMNOASCUS DESTRUCTANS IN CALIFORNIA.

Scott D. Osborn; Calif. Dept. Fish and Wildlife; 1812 9th Street, Sacramento, CA, 95521; (707) 499-0566; scott.osborn@wildlife.ca.gov; Deana Clifford, Bronwyn Hogan, Alice Chung-MacCoubrey

White-nose Syndrome (WNS) is a fungal disease that has killed millions of bats in eastern North America since it was discovered in 2007. The disease was first detected in western North America in Washington state in 2016 and low-level detections of the fungal agent have recently been found in other western states, including California. CDFW has worked with partners from several state and federal agencies, NGOs, and academia since 2011 to prepare for the arrival of WNS. These activities include the preparation of a state WNS response plan, coordinating with other agencies on disease surveillance, and public education. Members of the California WNS Steering Committee are now implementing and/or seeking funding for a variety of response activities to address the threat of WNS, including enhanced surveillance for the fungus and disease, population monitoring to assess the impact of the disease on bat communities, and research on the winter ecology of bats in the affected area to inform future disease management decisions.

Wildlife Diseases and Pathology

FINDING INITIAL INCURSIONS OF PD AND UNDERSTANDING POTENTIAL IMPACTS: NPS CONTRIBUTIONS TO DETECTING, EVALUATING, AND MANAGING FOR WNS IN NORTHERN CALIFORNIA.

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With the detection of the causative fungus for white-nose syndrome, Pseudogymnoascus destructans (Pd), in western North America, managers in the National Park Service (NPS), especially those at cave parks, have elevated concern about subsequent effects on bat populations and their options for managing the disease and its spread. Despite the small footprint of NPS lands in western states, the agency is making significant contributions towards WNS detection and response by providing local expertise, funding, and stimulating productive multiagency collaborations. Here we describe collaborative efforts among NPS staff and cooperators to detect the disease (through spring surveillance), characterize winter hibernacula, predict/evaluate impacts on bat populations, and evaluate treatment options (by studying nontarget effects of UV-C treatment on cave microbiota). We discuss progress and initial results of these efforts, such as the first low-level detections of Pd in California.

Wildlife Diseases and Pathology

THE FIRST SUSPECTED CASE OF PD IN CALIFORNIA: A PILOT STUDY MONITORING YUMA AND LITTLE BROWN MYOTIS COLONIES

Christina N Walker; Department of Biological Sciences, Humboldt State University; 1 Harpst Street,
White-nose Syndrome (WNS) has caused declines in myotis bat colonies in the eastern United States by more than 90%. In 2018 and 2019, the first suspected detection's in California of the causative fungus, *Pseudogymnoascus destructans* (Pd), were reported in *Myotis yumanensis* and *M. lucifugus* colonies in two human structures. Our study aims to locate winter roosts, monitor seasonal activity, and characterize roost behavior of the Yuma and little brown myotis in northern California. To locate winter roosts, we applied radio transmitters to 3-4 adults once a week for 1 month beginning in late September 2019. In total, we tracked 8 female and 7 male adults from late September through early November. We will describe roost behavior prior to migration, the results of our tracking efforts, and solutions to the challenges we encountered and future directions. Our preliminary results indicate that the composition of the roosts vary seasonally in age and sex, functioning as maternity colonies in the summer and transitioning into a mixed gender and juvenile-dominated roost in the fall. Our results will help inform management decisions regarding WNS monitoring and bat habitat conservation in the northwest region of North America.

*Wildlife Diseases and Pathology*  
**Student Paper**

**AVIAN IMMUNE RESPONSE TO PARASITIC INFECTIONS IN A NATURAL ENVIRONMENT**

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Haemosporidians are well known parasites that can cause avian malaria infections of hosts with variable levels of virulence that range from mild-chronic infections to severe infections that cause mortality. The innate immune response is often responsible for the suppression of new infections; however, many parasites have evolved means to evade the host immune response. Our aim is to determine how conserved avian immune response are when infected with haemosporidians. Through mist netting, blood samples were collected between May - September 2019 from 20 bird species. Samples were tested to determine infection status and parasitemia levels. To study immune response, three genes will be measured to compare gene expression levels between infected and non-infected birds. Additional testing will be conducted to determine co-infections with Borrelia, West Nile Virus, Avian Pox and Trypanosomes. Given potential co-evolution between parasites and hosts, parasite virulence, and impact of co-infections, we aim to understand the degree of conservation of the immune response within a natural system. We hypothesize that host immune responses will remain relatively well conserved with fluctuations in parasitemia and pathogenicity between species, in particular given co-infections status.

*Wildlife Diseases and Pathology*  
**Student Paper**

**ISOLATION AND CHARACTERIZATION OF AVIAN INFLUENZA VIRUS IN THE SACRAMENTO VALLEY**

*Troy D Cline,* California State University, Chico; Dept. of Biological Sciences, Holt Hall 205, Chico, CA, 95929-0515; (530) 898-4123; tdlcline@csuchico.edu; *Elizabeth Bianchini, Raymond J. Bogiatto, Robin Donatello*

Wild waterfowl are a major natural reservoir for influenza viruses. Recent disease outbreaks in humans and commercial poultry highlight the need for continued surveillance of avian influenza viruses (AIV) in wild waterfowl. Currently, AIV surveillance efforts are rendered less efficient due to a lack of knowledge of the host factors that determine waterfowl susceptibility to AIV infection. In 2014, highly pathogenic
Avian influenza virus of subtype H5N8 entered North America from Asia through the Pacific Flyway, spread widely across the United States, and was responsible for millions of poultry deaths. To better understand the risk posed by AIV circulating in California and the host correlates of infection, we collected cloacal swabs from 2,066 hunter-killed ducks across four years in the Sacramento Valley. The overall prevalence of AIV in waterfowl cloacal swabs was determined to be 11.8% with diverse virus subtypes represented. We observed a significantly higher infection rate in 2015-2016, a phenomenon that may be related to overcrowding on wetlands due to drought conditions. Northern shovelers had a statistically higher carriage rate (21.9%) relative to other species, an observation that may assist in the development of more strategic approaches to AIV surveillance on wetlands in the future.

Wildlife Diseases and Pathology

A NEW APPROACH FOR TREATING AVIAN BOTULISM

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Avian Botulism causes tens of thousands of waterbird mortalities annually. In western systems, conditions that foster botulism overlap key waterbird lifecycle events; specifically late season brood rearing, molt, and early fall migration/staging. Waterbird rehabilitation has advanced tremendously from experience gained in oil spill responses, when applied to botulism rehabilitation efforts, this experience results in faster recovery and increased assurance of long-term survival. We have a better understanding of secondary medical risks in captive waterbirds and the tools and techniques to mitigate these risks to promote successful recovery. Literature supports botulism rehabilitation consists of shade and clean water, however there is little information regarding physical condition pre- and post-rehabilitation. This lack of health data inhibits our understanding of recovery and effectiveness of rehabilitation. Our effort suggests that baseline metrics should be used to measure body condition and bloodwork parameters to evaluate recovery progress. In addition to initial treatment of fluids, antitoxin and vitamin supplementation, facilities and treatments that prevent birds from resting on their keels reduce risk of keel lesions and feather contamination. Housing birds on water helps maintain feather condition/waterproofing, encourages self-feeding and self-hydration. We saw success in treatment across multiple species and guilds previously discounted species like shorebirds.

Wildlife Diseases and Pathology
**Wildlife Responses to Fire and Post-Fire Restoration**

(is sorted by presentation order)

**IS SEVERE FIRE GOOD OR BAD FOR SPOTTED OWLS?**

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The question "is severe fire good or bad for spotted owls?" has been frequently asked in recent years. However, this question is overly simplistic, because the answer is likely scale- and context-dependent. We examined resource selection by spotted owls in a post-fire landscape, testing whether selection varied across individuals and whether such variation could be explained by differences in resource availability (i.e., functional response). We applied mixed-effects models to GPS tagging data from 20 spotted owls in the Sierra Nevada, California, USA. Selection/avoidance of severely-burned forest by individual owls differed based on the extent and pattern of severe fire within their home ranges. Individuals whose home ranges contained >5% of high-severity fire tended to avoid severely-burned areas, individuals selected smaller patches and avoided larger patches (>115 ha) of severe fire, and rarely made deep (>100-m) forays into severely-burned patches. Spotted owls avoided areas that had experienced post-fire salvage logging, but some owls showed even stronger avoidance for unlogged snag forest. Our findings suggest spotted owls are showing adaptive responses to conditions characteristic of historical fire regimes. Shifts in disturbance regimes that produce novel landscape patterns characterized by large patches of high-severity fire may negatively affect this species. We emphasize that whether severe fire is "good" or "bad" for spotted owls is nuanced yet predictable, and depends on the landscape ecology of fire, severe fire patch size, and individual variation.

*Wildlife Responses to Fire and Post-Fire Restoration*

**IMPACTS OF THE CARR FIRE ON WHISKEYTOWN STREAMS: THE ROLE OF NATIONAL PARK SERVICE LONG-TERM MONITORING IN STUDYING DIRECT AND INDIRECT IMPACTS TO THE ECOSYSTEM**

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The National Park Service has implemented long-term monitoring of the physical, chemical, and biological elements of Whiskeytown streams since 2011 as part of the Vital Signs monitoring program. Prior to the 2018 Carr Fire, the streams had been surveyed in 2011, 2014, and 2017. In the aftermath of the fire, a crew performed a subset of monitoring at safely accessible sites immediately post-fire to learn the direct impacts on sediment, invertebrates, and water chemistry. In 2019, a crew revisited sites to document the indirect impacts on the stream ecosystem. Results to date indicate that direct effects (heat, ash, etc.) have little to no effect of invertebrates, chemistry, or sediment, but indirect effects (loss of riparian cover, increased fine sediment, etc.) appear to have much larger effects. Invertebrate assemblages immediately post-fire were largely unchanged from pre-fire samples, but the assemblages in some streams had lost approximately half the number of taxa 9 months later. The multi-disciplinary nature of the Whiskeytown stream monitoring will allow for an integrated, holistic investigation into stream ecosystem impacts.

*Wildlife Responses to Fire and Post-Fire Restoration*
Mesocarnivores at Whiskeytown NRA after the 2018 Carr Wildfire

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Whiskeytown NRA in northern California supports a diverse array of mesocarnivore species, including several of special management concern, such as the Pacific fisher (Pekania pennanti) and ringtail (Bassariscus astutus). The ranges of these species coincide with areas with increasing risk of wildfire and a growing need for management of fire and fuels. Fires can reduce habitat suitability for some forest-associated species, including fisher, by removing canopy cover, but response of forest carnivores to wildfire is not well understood. As a part of a project to assess the occurrence and distribution of mesocarnivores in the Klamath National Park Network, camera surveys were conducted in Whiskeytown NRA in the fall of 2018, after the Carr Fire. The results provide a baseline inventory of carnivore species and important information about their immediate response to a severe wildfire. For example, results indicated that fisher and ringtail were still present in the burned area in the months immediately after the fire was extinguished. Because responses of wildlife to the burned landscape are expected to be highly dynamic following a fire, continued monitoring at Whiskeytown NRA would contribute significantly to an increased understanding of forest carnivore response to wildfire.

Wildlife Responses to Fire and Post-Fire Restoration

Landscape-level Pyrodiversity Promotes Diversity of Forest Carnivores, But Possibly Not of their Prey

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Ecological theory and a growing body of literature suggest that a diverse fire regime of low/high severities (e.g., pyrodiversity) promotes biodiversity. However, some researchers caution against full embrace of this paradigm in conservation biology, arguing that complex interactions across trophic/spatial scales need to be better understood. Using camera surveys from 670 sites across 44,000 sqkm of Northern California forests, I evaluated the effects of pyrodiversity on species richness of 16 carnivores and 11 of their rodent/lagomorph prey. I used N-mixture modeling to correct for imperfect measurement of species richness. I found that carnivore richness was highest at locations where 12% (90%CI: 9-16) of the landscape (e.g., 10-km radial area surrounding each survey site) burned at high severity, or 26% (90%CI: 19-40) burned at low severity, over the past 25 years. In contrast, I found a negative association between prey richness and fire (e.g., for either low or high intensity). These findings suggest that carnivores may benefit overall from landscapes managed for greater pyrodiversity. However, it remains unclear how pyrodiversity interacts across trophic levels. Future research evaluating the patterning of fire intensity, and distribution of prey abundance, at finer spatial scales could help answer this question.

Wildlife Responses to Fire and Post-Fire Restoration

Fire, Forest Restoration, and Spotted Owl Conservation under Climate Change

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In Sierra Nevada forests, large-scale restoration may reduce severe fires and increase forest resilience to climate change, but restoration techniques may remove key habitat used by rare and declining old-forest species. We simulated bioregional-scale effects of forest restoration (i.e., fuel reduction treatments) on (1) future severe fire activity and (2) population dynamics of spotted owls (Strix occidentalis) in the Sierra Nevada, USA. We developed a predictive model of future severe fire coupled with a spatial occupancy model for spotted owls, with behavior of both models linked to fuel treatments. Our findings suggest restoring historical forest structure may mitigate future severe fire activity in the Sierra Nevada as the climate warms and dries, particularly when fuel treatments occur within owl territories. On average, benefits provided by simulated fuel treatments to spotted owls (reducing severe fire activity) exceeded potential costs (direct habitat alteration) by mid-century at the bioregional scale. However, relative costs and benefits of fuel treatments to owls vary at finer scales, which can inform targeted restoration planning. Our study suggests that when large, old trees are maintained, fuel reduction and forest restoration in the Sierra Nevada is likely to benefit both old-forest species and forest ecosystem resilience under climate change.

*Wildlife Responses to Fire and Post-Fire Restoration*

**MALADAPTIVE NEST SITE SELECTION AND REDUCED NEST SUCCESS IN FEMALE SAGE-GROUSE FOLLOWING WILDFIRE**

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Increased wildfire frequency and associated replacement of sagebrush (Artemisia spp.) with invasive grasses contribute to declines of greater sage-grouse (Centrocercus urophasianus; hereafter, sage-grouse) populations across the Great Basin. However, little is known about wildfire impacts on habitat selection and specific population vital rates. We estimated effects of a 126,000-ha wildfire, bordering California and Nevada, on sage-grouse nest survival using before (2007-2009) and after (2015-2018) data within a before-after-control-impact experimental design. We also evaluated nest-site microhabitat effects on nest survival in burned and unburned habitat following wildfire. Although female sage-grouse continued to occupy burned areas, nest survival was reduced in those areas from 0.52 (95% CRI = 0.31-0.74) to 0.19 (95% CRI = 0.06-0.42). Following wildfire, sage-grouse used non-shrub nest cover more often and selected less shrub cover in burned than unburned areas. While sage-grouse continued to nest in wildfire-altered habitat, perhaps due to strong behavioral propensity for nest-site fidelity, they did so at a reproductive cost, and seemingly below replacement rates. Fire suppression or rapid post-fire habitat restoration, especially of shrubs, may be essential to conserving robust sage-grouse populations into the future. These findings are preliminary and provided to meet the need for timely best science.

*Wildlife Responses to Fire and Post-Fire Restoration*  

**WILDFIRE IMPACTS ON DEMOGRAPHIC RATES OF GREATER SAGE-GROUSE**

**Emmy A Tyrrell**; USGS/UC Davis; 800 Business Park Drive, Dixon, CA, 95620; (530) 902-9741; etyrrell@usgs.gov; Peter, S, Coates, Mark, A, Ricca, Brian, G, Prochazka, Joshua, M, Hull, Shawn, P, Espinosa

Sagebrush steppe ecosystems are increasingly threatened by invasive annual grass-wildfire cycles that continually alter sagebrush ecosystem recovery after disturbance, which can drive conversion of diverse sagebrush habitats to annual grass monocultures. While recent scientific findings have described long-lasting negative effects of wildfire on greater sage-grouse (Centrocercus urophasianus) populations within the Great Basin, wildfire impacts to demographic processes are lacking, predominantly because these data
are rare and logistically difficult to collect. We used long-term data collection (2009-2019) with natural experimental treatments enabled by large wildfires during 2016 and 2017 in the Virginia Mountains to construct a before-after-control-impact (BACI) design aimed at estimating effects of wildfire on demographic rates of sage-grouse. Preliminary results suggest wildfire substantially lowers nest survival, possibly by reducing direct concealment from overhead sagebrush cover and increasing susceptibility of sage-grouse to nest predators in a fragmented landscape. We also found decreased brood and adult survival following wildfire effects indicating that many vital rates important to population maintenance and growth were impacted by wildfire. Findings are preliminary and provided for timely best science.

*Wildlife Responses to Fire and Post-Fire Restoration*
COMPARISON OF AUTONOMOUS ACOUSTIC RECORDER UNIT OCCUPANCY SURVEYS TO NORTHERN SPOTTED OWL (STRIX OCCIDENTALIS CAURINA) DEMOGRAPHIC MONITORING AND SITE OCCUPANCY

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Autonomous acoustic recorder units (ARU's) have been growing in popularity for use in wildlife surveys and may be particularly useful for territorial species that regularly vocalize during territorial defense and mate attraction. Standardized protocol surveys for the federally threatened northern spotted owl involve broadcast surveys from points distributed along roads and trails in suitable habitat areas at night with follow-up surveys occurring generally in the daylight to locate activity centers of individuals and pairs and to determine reproductive status. We have been monitoring northern spotted owl demographics within the Hoopa Valley Indian Reservation in northern California since 1992, using the traditional broadcast and follow-up survey methods and including color banding and re-sighting of individuals each year. In 2019, we surveyed 51 territories using an array of ARU's over the course of the breeding season while simultaneously continuing our demographic monitoring. With data obtained from the ARU's, we estimated territorial occupancy using Program Presence to compare with our demographic monitoring efforts of the banded population of owls. ARU's detected owls in nearly every occupied territory however the estimates of occupancy were 10 to 30% higher than our demographic data suggested depending on how the ARU data was formatted.

DIET ANALYSIS USING FECAL METABARCODING FOR A THREATENED DESERT GROUND SQUIRREL

Erica L Orcutt; University of California, Davis; One Shields Avenue, Davis, CA, 95695; (408) 507-8362; elorcutt@ucdavis.edu; Cody M. Aylward, Barbara M. Leitner, Philip Leitner, Benjamin N. Sacks, Cody M Aylward

Fecal metabarcoding has become an increasingly common technique used to determine animal diets for ecological studies. We applied this technique to Mohave ground squirrels (Xerospermophilus mohavensis, or MGS), a Threatened species in California, to illuminate how plant food resource use varies between dry and wet years in the Mojave Desert. Previous work on MGS diets has suggested the presence of shrubs in the family, Chenopodiaceae, as fallback foods during drought periods; our present work aimed to test if those, or other key plants, were important for MGS during a drought in the southern range, where diet has never been studied. Using fecal metabarcoding on 52 fecal samples collected from three of the core populations defined in the MGS conservation strategy (CDFW 2019), we found that MGS used different food resources between wet and dry years. In wet years, MGS consumed primarily herbaceous plants, presumably because they were plentiful and nutritionally valuable, while they consumed less nutritionally available grasses, particularly Schismus spp., during dry years when little else was present in large quantities. Shrubs were consumed in large amounts in both wet and dry years, but two shrubs, creosote bush (Larrea tridentata) and burrobush (Ambrosia dumosa) appeared more important in wet compared to dry years. As in the north, Chenopod shrubs (Atriplex spp., in our study) were consumed both during dry and wet years, suggesting their role as important foods in the southern range as well. We conclude that
MGS consume less nutritious, but highly abundant, grasses during drought years, but select more nutritious herbaceous plants during wet years, when they are more available, and that shrubs are always a key food resource, but the composition of shrubs consumed may change depending on the precipitation conditions.

*MGS* consume less nutritious, but highly abundant, grasses during drought years, but select more nutritious herbaceous plants during wet years, when they are more available, and that shrubs are always a key food resource, but the composition of shrubs consumed may change depending on the precipitation conditions.

Wildlife Techniques and Technologies

**SALT MARSH HARVEST MOUSE LANDSCAPE GENETICS AND CONNECTIVITY WITHIN THE MARSHES OF SUISUN BAY**

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Understanding how populations of endangered species are subdivided and which landscape features impede gene flow helps conservation practitioners make informed management decisions. The largest remaining tracts of historical habitat for the salt marsh harvest mouse (SMHM) are found around Suisun Bay, making this area critical to the conservation of the species. The primary objective of this study was to assess how populations were subdivided and the levels of gene flow among SMHM within Suisun Bay. The second objective was to assess the role played by habitat features in creating population substructure. We trapped and collected 538 SMHM genetic samples from 26 locations and genotyped them with 20 microsatellite loci. Using cluster analysis and a population tree we identified a large population across the northern marshes of Suisun Bay, and smaller distinct populations on the Contra Costa shoreline and at Ryer Island. Landscape genetics analyses identified that water and elevation >2m constrained gene flow and mouse movement. This information can be used to help locate other potentially distinct populations of SMHM, both within Suisun Bay and elsewhere across the range.

Wildlife Techniques and Technologies

**TELEMETRY DATA MANAGEMENT IN R: TELEMETR**

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The volume of data has grown substantially over the last 10 year. Agencies are routinely deploying hundreds of GPS tracking devices a year. The animal movement data collected by these devices is an increasingly important tool for wildlife management. This increase in the volume of data has not been met with an awareness of sound data management practices. Over the last several years there have been attempts to simplify this process, and tools like MoveBank have been created. Using these tools can be inflexible and requires moving data between services, file formats, and software. To cope with these shortcomings I've developed a framework for the management, storage, and analysis of telemetry data within R. The goal of this tool is to give wildlife managers and scientists a suites of R packages, Shiny applications, and RStudio addins to simplify telemetry data management.

Wildlife Techniques and Technologies

**DOG DETECTIONS OF BAT AND SMALL BIRD CARCASSES IN WIND TURBINE FATALITY MONITORING**

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As wind turbine-caused mortality of birds and bats increases with increasing wind energy capacity,
accurate fatality estimates are needed to assess impacts, identify collision factors, and formulate mitigation. We tested detection dogs in trials involving randomly placed bat and bird carcasses in routine fatality monitoring at the Buena Vista and Golden Hills Wind Energy projects. We used a thermal-imaging camera to observe birds and bats flying around wind turbines at night to test for correspondence between behavior patterns and next-day fatality finds. Dogs found nearly all confirmed-available trial carcasses. Where dogs overlapped human searches at the same turbines at Golden Hills, dogs found 71 bat fatalities while humans found 1. Using dogs, we estimated much higher small bird fatality rates than previously reported. Whether bat fatalities would be found was predictable from observed passage rates through wind turbine rotors during nocturnal surveys, and passage rates peaked as nightly air temperatures increased with declining wind speeds in fall, and just prior to the next waxing moon phase. Accuracy and precision of fatality estimates at wind projects would greatly improve by using scent-detection dogs.

*Wildlife Techniques and Technologies*

**USE OF NONINVASIVE DNA TO ESTIMATE DENSITY AND STRUCTURE OF BLACK BEARS IN THE LAKE TAHOE BASIN**

**Julia D Owen;** University of California, Davis; 1010 West 8th Street, Davis, CA, 95616; (619) 933-0774; jdown@ucdavis.edu; Camilo, J, Sanchez, Sara, Holm, Shelly, Blair, Brett, Furnas, Ben, N, Sacks

As urban areas continue to encroach on adjacent wilderness, the number of human-wildlife interactions continue to increase. The American black bear (*Ursus americanus*) commonly habituates to human resources in regions of urban-wildland interface. Since 1957, the California Department of Fish and Wildlife has relied on bear tags and hunting data as indices of regional abundance to inform black bear management. Noninvasive genetic tools offer an opportunity to characterize abundance in smaller problem areas and provide detailed understanding of bear population structure, such as between urban and wildland habitats. We conducted a pilot study to assess the feasibility of a multi-year noninvasive genetic study in the Lake Tahoe Basin to estimate population structure and bear density. We discuss findings with respect to the efficacy of scat sampling, estimating the probability of population structure, and estimating density using spatial capture-recapture methods.

*Wildlife Techniques and Technologies*  
*Student Paper*
Drivers of Species Diversity in Suburban Environments: A Case Study of the Stanford University Campus

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Hypotheses of species diversity have been well developed and tested within unbuilt environments. We review existing theories of diversity in the context of urban environments and evaluate how well they explain patterns of species diversity on Stanford University's campus. At larger scales, species richness increases with area, consistent with the theory of island biogeography. At small scales, we document that relatively innocuous features of built environments present significant hazards to amphibians and reptiles. Over the last decade, utility boxes have acted as pitfall traps, capturing hundreds of amphibians and reptiles, including some federally and state threatened species. Understanding the drivers of species diversity in built environments can result in the development of infrastructure that better supports species diversity and reduces negative impacts on special status species.

Supporting the Integration of Climate Change Science and Adaptation Strategies into Fish and Wildlife Management

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Climate change and associated biological impacts pose a major challenge to natural resource management. It has become increasingly important to integrate climate science and adaptation strategies into long-term conservation planning as well as on-the-ground land management and resource assessment efforts. The Science Institute's Climate Program (Program) at the California Department of Fish and Wildlife (CDFW) is developing materials and tools to help Department staff evaluate the projected climatic changes in their region and identify potential impacts to the resources they manage. Over the past two years, the Program has developed a compendium of climate summaries that include information on climate projections, vulnerable species and habitats, and potential adaptation strategies for 19 ecoregions in California. The Program has also evaluated the resilience and vulnerability of CDFW lands to inform long-term strategic planning and on-the-ground resource management decisions. The poster will cover background, methods and assessment results from both projects, including an overview of climate vulnerability and resilience information for specific lands and associated wildlife, as well as ecoregional trends. These projects were made possible through close collaboration with the Stanford's Woods Institute for the Environment and the Haas Center for Public Service, a partnership that will be highlighted in the poster.

Regional Conservation Investment Strategies Program: A New Conservation Tool

Brandon P Amrhein; California Department of Fish and Wildlife; P.O. Box 944209, Sacramento, ca, 94244; (916) 651-8797; brandon.amrhein@wildlife.ca.gov; Ami Olson, Shannon Lucas, Ron Unger
On September 22, 2016, Governor Brown signed Assembly Bill 2087, establishing the California Department of Fish and Wildlife's (CDFW) Regional Conservation Investment Strategies (RCIS) Program. The RCIS Program enables development of regional conservation strategies to identify opportunities for philanthropic investments and advance mitigation that would result in effective regional conservation. The RCIS Program promotes the use of existing science to identify and prioritize region-specific conservation actions to help California's declining and vulnerable species by encouraging the protection, restoration, and reconnection of their habitats, and facilitating adaption and resilience to climate change, invasive species, and other stressors. These actions may include land protection, habitat restoration, installation of wildlife crossings, and removal of fish passage barriers. The RCIS Program consists of three components: Regional Conservation Assessments (RCAs), Regional Conservation Investment Strategies (RCISs), and Mitigation Credit Agreements (MCAs). Strategies are developed in an RCIS and actions may be carried out through an MCA, which creates credits to be used as compensatory mitigation for impacts under state and federal laws. This poster will further explain each of the Program component's benefits and uses in relation to conservation and recovery of sensitive species and how the Program relates to other CDFW conservation planning instruments.

**POSTER SESSION**

**PREVALENCE OF BABESIA AND MALARIAN DISEASES ON COMMON MURRES TO BE LINKED TO SUDDEN HIGH MORTALITY RATES**

**Jenna Aquino; 627 Bellevue Ave, Daly City, CA, 94014-1269; (659) 898-2006; jaquino6@mail.sfsu.edu; Wilmer Amaya-Mejia, Rebecca Duerr, Ravinder Sehgal**

Common Murres are a species of seabirds that are numerously found along California's coast. As of recent, there have been unusual unknown high mortality rates, until we had reason to suspect of the protozoan parasite *Babesia*, known to infect blood cells. The International Bird Rescue detected individuals coming to the center with diagnoses of anemia believed to be infected with *Babesia* spp. We tested Common Murres throughout their stay to determine infection rates of *Babesia* spp. and to assess their potential to acquire novel *Plasmodium* spp infections. Blood samples were tested through PCR and microscopy work for *Babesia* spp. as well as other avian diseases such as *Haemoproteus, Plasmodium, Borrelia* and *Leucocytozoan* spp. 11 (9%) individuals were found to be positive for *Babesia* through PCR and microscopy, 9 (7%) individuals were found to be positive through microscopy alone and 9 (7%) individuals were identified as positive through PCR alone with a total of 29 (23%) infected individuals. They were found negative for apicomplexan infections. Unfortunately, we encountered false positives for *Borrelia* spp. due to our primers amplifying bird DNA. For future studies, we would like to explore the potential vectors of ticks for *Babesia* in Common Murres.

**Poster Session**

**COMMON RAVENS AND OTHER PREDATORS DISRUPT GREATER SAGE-GROUSE LEKKING ACTIVITIES**

**Joseph L. Atkinson; U.S. Geological Survey, Western Ecological Research Center; 800 Business Park Drive, Ste. D, Dixon, CA, 95620; (916) 293-1161; jatkinson@usgs.gov; Peter S. Coates, Mark A. Ricca, Ian A. Dwight**

Expansion of human enterprise has contributed to increased abundance and distribution of common ravens (*Corvus corax*) across North America, including vast sagebrush ecosystems of the Great Basin. Here, these generalists are highly effective nest predators of sensitive prey species such as greater sage-grouse (*Centrocercus urophasianus*) whose population trends index ecological health of sagebrush ecosystems.
Sage-grouse population trends are tracked through counts of males attending traditional breeding grounds, known as leks, where they are sensitive to disturbance. Ravens may represent a perceived risk at leks despite being non-lethal to adult sage-grouse. Hence, we compiled 19 years (2000-2018) of lek observations and analyzed sage-grouse reactions to ravens and known lethal predators within a Bayesian framework. Results indicated that presence of ravens decreased the likelihood of sage-grouse displaying and increased the likelihood of sage-grouse flushing from lek sites. While lethal predators, such as large raptors, had stronger effects on sage-grouse behavior, ravens disrupted attendance and displays of lekking sage-grouse in ways similar to lethal predators. These results indicate accounting for raven presence could improve lek count indices and expose a less known impact of ravens on sage-grouse reproduction. These findings are preliminary and provided to meet the need for timely best science.

**Poster Session**

**OPTIMIZING DNA RECOVERY FROM MUSEUM SPECIMENS OF SALT MARSH HARVEST MOUSE AND ANALYSIS OF HISTORICAL GENETIC DIVERSITY**

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Salt marsh harvest mouse (SMHM; *Reithrodontomys raviventris*) is a federally endangered species endemic to marshes of the San Francisco Estuary. Approximately 90% of historical SMHM habitat has been lost to land development in the past century. Understanding the impact of habitat loss and population extirpation on genetic diversity and connectivity is important to aiding the recovery and long-term persistence of SMHM. We used modern (2010-2019) and museum specimens (1908-1975) collected from throughout SMHM range to estimate the loss of genetic diversity over the past century. First, we tested the performance of two DNA extraction protocols ("Vacuum" and "Centrifuge") and two tissue types (skin and toe) for obtaining DNA from museum specimens. Based on analyses of DNA recovery and amplification success we proceeded with the collection of 70 toe samples from the Museum of Vertebrate Zoology. The optimized protocol was used to extract SMHM DNA from museum specimens. We amplified the control region (D-loop) of mtDNA from samples and calculated diversity indices. Results of this study will provide insight into the historical genetic diversity and reveal potential genetic consequences of habitat loss for this endangered endemic rodent.

**Poster Session**

**Student Paper**

**PROJECT WAFLS: AN EIGHT STATE SHORT-EARED OWL SURVEY EFFORT**

**Carie L Battistone;** CA Department of Fish and Wildlife; 1812 Ninth Street, Sacramento, CA, 95682; (916) 445-3615; Carie.Battistone@wildlife.ca.gov; Robert Miller, Heather Hayes, Matt Larson, Ellie Armstrong, Joseph Buchanan, Joe Barnes, Nelson Holmes, Zoe Nelson, Colleen Moulton

The Short-eared Owl (*Asio flammeus*) is an open-country species that has likely experienced a longterm, range-wide population decline. The cause and magnitude of the decline are not well understood. The Western Asio flammeus Landscape Study (WAfLS) program began in 2015 with a two state effort and has since expanded to an eight western state effort in 2018 and 2019, California being one. All eight western states were stratified by presumed Short-eared Owl habitat and grids were randomly selected within the stratum. A survey route was selected within each grid cell along secondary road. Participants, primarily volunteers, were responsible for two surveys in their assigned grid during the early breeding season. Observers surveyed points separated by a ½ mile prior to the end of local civil twilight, completing 8-11 points during a 90-minute span. At each survey point observers collected data on Short-eared Owl observations, along with basic habitat information. In 2018, a total of 622 participants surveyed a total of 399 grids, with Short-eared Owls detected in 68 of the grids. In 2019, a total of 605 participants surveyed
365 grids, and detected owls in 63 of the grids. A multi-scale occupancy and Maximum Entropy modeling was used to analyze 2018 and 2019 data. Occupancy rates vary by state, being higher in more northern locations. Densities vary significantly year-to-year and with geography, illustrating the importance of long-term monitoring. Participating states will continue survey effort into 2020.

Poster Session

BODY CONDITION OF BARRED OWLS (*STRIX VARIA*) IN THE PACIFIC NORTHWEST

Ryan C Baumbusch; Oregon Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife, Oregon State University; 104 Nash Hall, Corvallis, OR, 97331; (760) 470-6716; ryan.baumbusch@oregonstate.edu; Katie M. Dugger, J. David Wiens

Barred owls (*Strix varia*) recently expanded their distribution across North America and their range now completely overlaps that of the federally threatened northern spotted owl (*Strix occidentalis caurina*). Barred owls negatively influence northern spotted owl demographics through competition and competitive exclusion, and high densities of barred owls now occur in some parts of their expanded range. To understand the broader ecological effects of barred owls in the Pacific Northwest, we investigated body condition and prey accumulation rates of barred owls from three study areas in Oregon and Washington over a 3-year period where birds were collected as part of a large-scale removal project. We scored the amount of subcutaneous fat on 957 owls. Preliminary results show a strong annual cycle in fat deposits, where peak fat deposits occurred in winter, and the lowest fat reserves occurred at the end of summer. Females stored more fat than males, and adults stored more fat than subadults. Owls from the Washington study had the smallest fat deposits, while owls from Roseburg, OR had extensive fat deposits. Dietary differences between the study areas may explain some differences in body condition.

Poster Session Student Paper

IMPACTS OF THE 2015 ROUGH FIRE AND PRESCRIBED FIRE HISTORY ON BATS IN KINGS CANYON NATIONAL PARK

Samantha R Bever; Fresno State University, Department of Biology; 2555 East San Ramon Ave, M/S SB73, Fresno, CA, 93740; (661) 236-3152; sbever@mail.fresnostate.edu; Joshua S. Reece, Shelby P. Moshier, Chrisionna N. Graves, Robert T. Seward

The lightning-ignited Rough Fire burned through forests of Kings Canyon National Park in 2015. Because the surrounding forests have a well-recorded and varied history of prescribed fires, we made use of this mosaic to test the impacts of the Rough Fire on bat biodiversity. We used nine acoustic recorders in a fully nested design across 4 treatments: A) Burned by Rough Fire with a history of prescribed fires, B) Burned by Rough Fire without a history of prescribed fires, C) Not burned by Rough Fire and without a history of prescribed fires, and D) Not burned by Rough Fire but with a history of prescribed fires. We used year-round acoustic monitoring for four years. Our results reveal a clear phenology to bat acoustic activity with a peak around July-August. We found no difference in overall bat activity or species richness across treatments, but we did find a relatively higher proportion of low-frequency echolocations in treatments with catastrophic fire effects and a higher proportion of high-frequency echolocations in treatments without a history of fire. These findings are consistent with previous work showing that low-frequency echolocating bats favor open woodlands, while high-frequency echolocating bats favor more cluttered woodlands.

Poster Session Student Paper
SEASONAL PRESENCE AND FORAGING PATTERNS OF BATS AT CALIFORNIA VERNAL POOLS

Leandra C Boodoo; California State University, Chico; 400 West First Street, Chico, CA, 95929; (570) 369-2914; lcboodoo@mail.csuchico.edu; Shahroukh Mistry, Donald G. Miller III, Amanda I. Banet, Raymond J. Bogiatto, Colleen A. Hatfield

California vernal pool landscapes are isolated ephemeral wetlands where underlying hardpans cause grassland depressions to fill with seasonal rainwater before drying by summer. The pools, which are vital habitat for several rare and endemic flora and fauna, continue to decline almost exclusively due to agricultural conversion. Studies have investigated aquatic biodiversity and some terrestrial vertebrates, but bat activity remains unknown. We hypothesized that bats use these habitats to forage and drink. Acoustic recorders were installed to record nightly in 2019 at Pool 22 of Vina Plains Preserve in Tehama County, beginning April 20, and at an upland control site 1 km away, starting May 29. We documented substantial bat activity on the landscape. Mean nightly bat passes were higher at the pool (mean = 53) than the control site (mean= 3) during the hydroperiod. Activity decreased as pools dried but peaked again in mid-August, possibly signifying changes in insect availability. Call analysis through June 30 revealed foraging during 47.0% of nightly bat passes at the pool and 12.1% at the control. This study is the first to detail bat presence and foraging at California vernal pools and has conservation implications that can benefit bats, vernal pools, and private landowners.

Poster Session  Student Paper

IDENTIFYING LEAST CONFLICT LANDS FOR RENEWABLE ENERGY DEVELOPMENT

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In 2015 a stakeholder led process was carried out for the San Joaquin Valley, California, to identify areas for potential solar development. The goal was to explore how multiple and diverse parties could quickly (within six months) identify least-conflict lands for solar photovoltaic development from their perspectives. The San Joaquin Valley is playing a big role in California's goal to reach 100% renewable energy by 2045. The Valley includes some of the most productive farmland in the world including some of our most imperiled plants, animals and natural habitats. As a result, identifying good locations for solar projects can entail significant controversy. The stakeholder work utilized the Data Basin San Joaquin Valley Gateway (www.sjvp.databasin.org), a web-based resource that supported the stakeholder groups with their mapping exercises and houses the resulting data. The project findings can therefore be updated, used to inform a variety of stakeholder and decision-maker forums, and replicated in other regions. By including all stakeholders in the process, there is a mutual understanding that the goal is to reduce conflict and accelerate renewable energy deployment while protecting farmland and native species and habitats.

Poster Session

PARTIAL CONSUMPTION OF PREY IN BARRED OWL (STRIX VARIA) DIETS

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Barred owls (Strix varia) recently expanded their range across North America, and now live alongside and compete with the federally threatened northern spotted owl (Strix occidentalis caurina). The success of barred owls may be due, in part, to their broad diet. Previous diet studies of barred owls relied on egested pellets, which present some problems in quantifying the biomass consumed of the various prey species,
such as accounting for large prey items that could not have been consumed whole. To better understand the energetic contributions of the diverse prey taken by barred owls we identified stomach contents of barred owls collected in a large-scale removal experiment, recording which prey were eaten whole or in-part. From 1,329 barred owls we documented 4,966 prey items. In our preliminary results a logistic regression showed that prey items heavier than 100 g were less likely to be consumed whole. Prey taxa such as leporids, mountain beavers, and gray squirrels were always partially consumed. Mid-sized prey for barred owls such as flying squirrels, chipmunks, moles, and adult coastal giant salamanders were sometimes partially consumed.

Student Paper

ESCHERICHIA COLI AND SALMONELLA ENTERICA IN ROOSEVELT ELK (CERVUS CANADENSIS ROOSEVELTI) AND CATTLE: ENTERIC PATHOGENS AT THE WILDLIFE-DOMESTIC INTERFACE

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Direct or indirect contact between domestic animal and wildlife populations carries risks for transmission of infectious agents, and wildlife are often implicated as sources of contamination that can cause outbreaks of illness in humans. Salmonella enterica and Escherichia coli are both ubiquitous, well-characterized, bacterial pathogens with the potential to cause mild to serious disease and death in humans, domestic cattle and wildlife. Cryptosporidium sp. is a apicomplexan intestinal parasite that also causes significant human disease worldwide and can have a significant impact on commercial livestock. In northern California, the Roosevelt elk (Cervus canadensis roosevelti) population utilizes a variety of habitats including pastures of commercial cattle operations in both Humboldt and Del Norte counties: the shared space, forage and possible interactions between these species is of concern to ranchers. We are testing elk and cattle feces for prevalence and strains of E. coli, S. enterica, and Cryptosporidium sp. including elk groups both associated and not associated with cattle. The prevalence and strain types of these pathogens will provide insight into the nature and degree of interactions. This project, utilizing elk GPS collar data to augment range overlap analysis, is a first step in examining pathogen communities among these populations. This is a work in progress, and results are pending.

Student Paper

AN EVALUATION OF MITIGATION INVOLVING THE SAN FRANCISCO DUSKY-FOOTED WOODRAT

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The San Francisco dusky-footed woodrat, Neotoma fuscipes annectens (woodrat), is an endemic species to the San Francisco Bay area and is listed as a Species of Special Concern in California. The California Environmental Quality Act (CEQA) was enacted to require projects to avoid or mitigate negative effects to the environment, including Species of Special Concern. While mitigation is required in project areas where woodrats are present, the results of these mitigation efforts are often unknown. I examined the CEQA documentation for seven projects that included woodrat mitigation and reviewed the clarity and completeness of the documents and the types of mitigation undertaken. For three sites at which woodrats were translocated as a mitigation tactic, I conducted surveys of woodrat midden activity to collect field data on the effectiveness of the translocation. Analysis of CEQA documents showed that the key mitigation tactics described were avoidance, buffers, habitat enhancement and translocation. Preliminary analysis of the three field sites indicates that woodrats were not using dismantled relocated middens and
the survival of translocated woodrats is unknown. I suggest science-based principles and conservation-driven strategies for mitigating for the presence of San Francisco dusky-footed woodrats to improve the protection of this species.

Poster Session

DECADES OF MONITORING TRENDS IN A PROTECTED BREEDING BIRD ASSEMBLAGE TO IMPROVE RIPARIAN CONSERVATION

David L Rienche; East Bay Regional Park District; 2950 Peralta Oaks Court, Oakland, CA, 94605; (510) 544-2319; driensche@ebparks.org; Alan Chan-Alvarado, Christopher L. Kitting, Alan Chan-Alvarado

Natural riparian systems are critical for birds and other wildlife yet are disappearing as a result of habitat alteration and degradation. Documenting yearly trends in avian populations and communities in riparian habitats can inform management recommendations. We surveyed breeding bird assemblages at a suburban wetland park in Central California across three time periods (1994 to 1998, 2004 to 2008, and 2014 to 2018). Of the seventy bird species observed there, twenty-two species were known to breed and four are classified as riparian focal species for conservation. Bird species richness, diversity, and evenness showed little variability among years; however, total individuals of all species territories, combined, showed statistically significant declines overall. Eight out of twenty-two species showed substantial declines, including those of notable conservation interest: Common Yellowthroat (Geothlypis trichas), Wilson's Warbler (Wilsonia pusilla), and Song Sparrow (Melospiza melodia). These changes were not related to any measurable alteration in vegetation type, or species on the plot, or precipitation/climate, but may be related to changes in habitat size and shape or changing land use patterns nearby. Management recommendations to benefit the avifauna include adaptive management during continued monitoring, and expansion of the park's riparian habitat by enhancing plants in surrounding area restorations.

Poster Session

GOING BEYOND BROODSTOCK BASED CONSERVATION: GENETIC DIVERSITY IN WHITE STURGEON (ACIPENSER TRANSMONTANUS) REPATRIATED LARVAE IN THE SNAKE RIVER, IDAHO

Amanda E Coen; UC Davis, Genomic Variation Lab; One Shields Avenue, Davis, CA, 95616; (818) 324-0207; aecoen@ucdavis.edu; Andrea Schreier, Phil Bates, Ken Lepla

Captive breeding and supplementation programs are important tools for conserving threatened species but can have far reaching implications for the genetic diversity of managed populations. White Sturgeon (Acipenser transmontanus) conservation supplementation programs in the Snake River, Idaho mitigate for poor reproduction due to negative effects of dams, including reduced connectivity, modified hydrographs, and for some reaches, habitat limitations. At sexual maturity White Sturgeon exhibit large body size, limiting the number of individuals that facilities can maintain as broodstock for a season. While broodstock based supplementation has traditionally been employed for White Sturgeon, an alternative approach is repatriation. This method involves collecting fertilized eggs from natural spawning events and raising them in a hatchery environment. Repatriation not only allows for increased survival of progeny, it also enables managers to provide individuals for supplementation that represent a greater diversity of spawning individuals. In 2019, a much larger number of larvae were collected for repatriation from the Bliss to CJ Strike Reach than ever before. We examined the genetic diversity of the 2019 repatriation cohort and compared with previous cohorts to determine whether more genetic diversity was represented with the larger number of samples collected.

Poster Session

Student Paper

Student Paper
ESTIMATING ABUNDANCE AND DENSITY OF A HARVESTED UNGULATE POPULATION USING AN INTEGRATED MODELLING APPROACH

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Spatial capture-recapture (SCR) models are one of the most widely used methods for estimating population abundance and density as a function of spatial and environmental variables at ecologically realistic scales. Robust estimates of abundance and density are vital for biologists that manage populations of species of conservation concern that are also harvested, as an understanding of population size, demographic composition, and temporal dynamics is necessary to set sustainable harvest quotas. The southern mule deer (*Odocoileus hemionus fuliginatus*) is a harvested subspecies of mule deer that is also a species of conservation concern in southern California. Previous population estimation methods for this subspecies have not been spatially explicit and therefore accurate population density estimates remain unknown. To improve our local and regional estimates of these populations, we used an integrated SCR modeling approach employing deer fecal DNA, GPS telemetry, and opportunistic observations in a 157 km$^2$ sampling region in southern California. Using different combinations of these data sources to compare model performance, we demonstrated that incorporating multiple sources of data can improve precision of abundance and density estimation of southern mule deer. This integrated approach is a powerful population estimation tool that can be scaled to inform management decisions.

Poster Session    Student Paper

ASSESSING HABITAT USE BY THE HAWAIIAN HOARY BAT IN HELEMANO WILDERNESS RECREATIONAL AREA, O'AHU.

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At the end of 2018, The Trust for Public Land and The Hawai'i Department of Land and Natural Resources (DLNR), Division of Forestry and Wildlife (DOFAW) purchased just over 1,166 ha of fallow agriculture land in central O'ahu. A portion of the funds used to purchase this area, known as Helemano Wilderness Recreational Area (HWA), came from Kawailoa Wind Tier 4 mitigation, to preserve and protect vital uninterrupted Hawaiian hoary bat (*Lasiurus cinereus semotus*) habitat. In order to protect this endangered bat species, we must first understand how they use this specific piece of land. This study will use eight ultrasonic acoustic detectors placed in pasture and evergreen forest to determine if one of these habitats is preferential for bat foraging. The results of this study will inform HWA's land managers (DOFAW) about the best way to move forward as they turn portions of HWA into public campgrounds and recreational areas.

Poster Session    Student Paper

INTRAPOPULATION FORAGING RESPONSE OF CALIFORNIA SEA LIONS (*ZALOPHUS CALIFORNIANUS*) TO ENVIRONMENTAL STRESS

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Periods of oceanographic thermal variation in the Northeast Pacific, characterized by an El NiÑo and a
Pacific marine heat wave ("The Blob"), occurred between 2013 and 2017. These thermal fluctuations diminished primary productivity, which reduced carbon transfer throughout the marine food web. Although the California sea lion (Zalophus californianus) consumes a variable diet, reflective of an opportunistic consumer, distinct individual foraging responses to fluctuations in prey availability persist within the population, although the prevalence of these responses is unknown. Stable isotopes can inform foraging ecology as they deposit in tissues after the metabolization of prey and will indicate general forage location and trophic level (carbon and nitrogen, respectively) of prey. Vibrissae (whisker) tissue of adult Z. californianus grow at a continuous rate and remain chemically inert after growth, thus storing isotopic ratios along vibrissae and generating a timeline of forage habits. Vibrissae were collected from deceased Z. californianus adult females from an important rookery. We analyzed the isotopic ratios of vibrissae segments across environmental warming trends between 2013 and 2017 to delineate forage location and trophic level of prey consumed at relative time periods and to what extent variation within the population persists through perturbations.

**Poster Session  Student Paper**

**OPTIMIZING TISSUE SAMPLING AND EXTRACTION PROTOCOLS FOR NEXT-GENERATION GENOMIC SEQUENCING**

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The application of genomic tools in wildlife studies allows researchers to characterize and monitor populations, as well as understand mechanisms affecting genetic variation, adaptation, and evolution. However, these tools depend on high-quality genomic DNA sources, which typically come from tissues rather than noninvasive sources. Opportunistically collected samples (e.g., road-killed carcasses) may be an important genomic source for some species, but can result in highly variable DNA quality depending on freshness and environmental conditions. The primary objective of this study was to determine optimal guidelines for sampling and extracting field specimens to maximize DNA quality for genomic sequencing. Using red fox (Vulpes vulpes) carcasses in various stages of decay, we extracted DNA from multiple tissue types using two common extraction methods: silica membrane binding (DNeasy®) and salting out precipitation (Gentra® Puregene®). We found no significant difference between extraction method across all decay levels and tissue types, however we found that Gentra® Puregene® is both more costly and more time consuming. We found that in fresh samples muscle, gonads, and skin, produced the highest quality of DNA. However, in more degraded specimens, nose and tongue yielded the highest quality of DNA.

**Poster Session  Student Paper**

**HABITAT USE AND OVIPOSITION SITE SELECTION OF A DISJUNCT POPULATION OF RED-BELLIED NEWT (TARICHA RIVULARIS)**

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Red-bellied newts are a poorly-studied species that recently warranted listing as a California Priority 2 Species of Special Concern. In 2010, approximately 130 km south of the southern edge of the core red-bellied (Taricha rivularis) newt habitat, a disjunct population was discovered in a relatively well-protected preserve in Santa Clara County. Presence-absence surveys conducted during the breeding season 2018 (February to May) revealed red-bellied newts were found in a 1,000-meter section of upper Stevens creek and in a small tributary colloquially named "Twitty" Creek. During the breeding season of 2019, additional surveys were conducted in both Upper Stevens creek and Twitty creek to describe habitat use. Habitat
parameters collected included substrate type, substrate size, depth, mesohabitat type, mesohabitat type, channel position, canopy cover, and cover type from previously identified locations of breeding males to predict. Habitat parameters were evaluated as predictors of female red-bellied newts oviposition site selection and habitat use breeding males compared to sympatric newt species (Taricha granulosa and Taricha torosa).

**Courtship Flight Size in Northern Pintail Ducks (Anas Acuta)**

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Courtship flights are a form of courtship display found in many species of waterfowl (Anatidae). These flights consist of two or more males in pursuit of a single female in an attempt to gain her attention. Such aerial displays are energetically costly and conspicuous, which may increase the risk of predation. In the context of game theory, male birds should choose whether to join a courtship flight based on cues from other males of the same species. Because courtship flights are costly, males may join a courtship flight with fewer males, as it increases their likelihood of being selected as a mate. If so, the number of males in courtship flights may reflect an optimal group size. Alternatively, if males do not join flights conditionally according to group size, the number of males observed may reflect a random distribution. To test these predictions field data was gathered on Northern Pintails (Anas acuta) in the Sacramento Valley, California. The maximum number of males in each flight was recorded. Using these data a histogram was constructed of courtship flight size frequency. The observed distribution of courtship flight size was compared for goodness of fit to a normal distribution and a Poisson distribution.

**Factors Influencing Larval Salamander Densities in Existing and Recently Created Ponds**

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This study analyzed data from nine created ponds and one existing pond, to compare A. californiense larval data to aquatic and terrestrial factors associated with each pond. This study hypothesized that larger and deeper ponds will produce higher densities of larval salamanders as those ponds tend to retain water for longer periods of time, allowing successful breeding and survival of larvae. This study also compared larval amphibian densities to terrestrial habitat surrounding each pond including vegetation density (residual dry matter) and burrow densities. This study occurred in eastern Alameda and Contra Costa County, California, and compared results of ten ponds ranging widely in size and depth, and having similar aquatic characteristics (e.g., vegetation). During the wet year (2017) populations differed, but not based on pond size, with the second smallest pond (324 m²) having the highest number of larval A. californiense (147) followed by the largest pond size (2,428 m²) having 82 larvae. The shallower ponds yielded highest populations of larval A. californiense while two of the three deepest ponds yielded the lowest populations of larval A. californiense. Results indicated with relatively high probability, the highest density of larval A. californiense was observed in ponds 0.5 - <1 m deep.
EVIDENCE OF THE INFLUENCE OF PREDATION AND COMPETITION ON NEST DENSITY AND NESTING SUCCESS IN CALIFORNIA LEAST TERNS

Kadi L Erickson; California State University, Long Beach; 1250 Bellflower Boulevard, Long Beach, CA, 90840; maybekadi@yahoo.com; Christine, Whitcraft, Spencer, Langdon, Nick, Liberato

The California least tern (*Sternula antillarum browni*) is an endangered subspecies of migratory bird which nests on the west coast of North America. They lay their eggs in scrapes in the sand on open beaches and mudflats that have access to fish for themselves and their young. Since being listed as federally endangered in 1970, California least tern colonies have been monitored in protected, fenced colonies by biological management teams across their distribution from Northern California, USA to Baja California, MX. In these colonies, terns and their nests are susceptible to competition for space with other terns and predation by mammals and raptors. In this study, we used six years of past data on the spatial arrangement of nests and data on nesting success to evaluate nesting patterns in one colony in the Port of Los Angeles. Using the nearest neighbor package in ArcGIS, we found that the distribution of nests at this colony shows increased clustering in years when the tern colony experienced interspecific competition from other birds for space on the nesting site. Understanding and analyzing the factors behind distribution may facilitate management of these nesting sites and increase nesting success. (This project is currently a work-in-progress, to be complete by the time of the conference)

Poster Session

PREVALENCE OF ASYMPTOMATIC AVIAN POX IN CALIFORNIAN HUMMINGBIRDS

Aoife N Galvin; San Francisco State University; 285 Buckingham Way, Apt. 905, San Francisco, CA, 94312; (714) 732-3840; agalvin@mail.sfsu.edu; Ravinder, Sehgal, Lisa, Tell, Ruta, Bandivadekar

Avian pox is a well-studied virus that infects over 23 orders of birds around the world, but little is known about the strain that infects hummingbirds. Anna's Hummingbirds in California are known to be infected with avian poxvirus, but other Californian hummingbirds appear outwardly to not be affected. Anna's hummingbirds co-inhabit areas in California for large parts of the year with other species, such as Allen's and Black-chinned Hummingbirds, and use the same feeders and feeding sites. Why avian poxvirus does not seem to spread to these species is unknown. One hypothesis is that these other species are sub-clinical carriers of poxvirus and thus do not present the traditional pox lesions on their extremities. To test this, we will screen feather samples from all hummingbird species found in several study sites in California for avian poxvirus using a newly developed qPCR protocol. This will allow analysis of not only the prevalence of the virus in each species, but also of the distribution of pox in California. The study sites will be located in Southern and Northern California, enabling comparisons of pox prevalence in different regions of the state. Ultimately our research may pinpoint the origins of the virus in hummingbirds. I am a current master's student, the paper is a work in progress.

Poster Session

PREDATION ON BREEDING WESTERN SNOWY PLOVERS IN SALT POND

Jessica Y Gonzalez; Department of Environmental Studies, San Jose State University; One Washington Square Hall, San Jose, CA, 95192; (408) 391-9517; jessicagonzalez19@gmail.com;

The Western snowy plover (*Charadrius nivosus nivosus*), is a small shorebird listed as federally-threatened species. The Pacific Coast Population (PCP) of this species has been declining due to human disturbance, changes to their habitat, loss of breeding habitat, and high nest depredations by predators. The San Francisco Bay Recovery Unit (RU3) supports an important sub-population the PCP that encompasses a highly-modified urban environment (former salt ponds & berms). Due to the continued predation pressures

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on breeding Western snowy plover (WSPL), the study conducted was to investigate the effect of predation on breeding WSPLs nests in salt ponds (E14, E13, and E12) in Eden Landing Ecological Reserve, Hayward, CA during the 2019 breeding season (March to August). Research conducted to understand the predation impacts on breeding WSPLs was to examine the abundance, behaviors, habitat use and habitat features used by predators. For nesting WSPLs, I examined how nest location, spatial distribution of WSPL nests along with habitat features and nearest nesting neighbors (plover or California least tern) can potentially affect predation of WSPL nests. Additionally, secondary data collected by San Francisco Bay Bird Observatory during the breeding season from 2014 to 2018 was used to examine predation effect on breeding WSPLs.

**MONITORING LIGHT AND TEMPERATURE FACTORS FOR NESTING SUCCESS AND HABITAT CHOICE IN THE CALIFORNIA LEAST TERN**

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The California least tern (*Sterna antillarum browni*), a federal and state-listed endangered species, nests along the coast of California and Baja, Mexico. The California least terns openly nest on beaches and mudflats allowing foraging in estuaries and the open ocean. The location of their nests on the ground puts them at great risk of disturbances. thus habitat management now focuses on protecting the nesting sites along the coasts by enclosing nesting areas and closely monitoring nesting success. This migratory bird arrives along the coasts in April and continues the nesting season until September. Little is known about whether physical parameters such as light and temperature during these warm months affect nesting success and habitat choice of the California least tern. From May to August 2019, we monitored surface and ambient temperature in a small colony of least terns at the Port of Los Angeles. We found that temperatures at the sediment surface (where nests are located) were, on average, 20°C higher than the ambient recorded air temperature. This provides a more accurate picture of the temperatures that nests and chicks experience and can help evaluate if temperature is a key factor in nesting success of the California least tern.

**BAT ACTIVITY AS A FUNCTION OF LUNAR CYCLES**

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Previous work in the tropics has shown that bats may modulate their activity as a function of lunar cycles to avoid heightened predation risks from owls during the full moon, and reduced capacity to see their own insect prey during moonless nights. It is unclear if bats in temperate regions of the American West show similar patterns of activity in relation to lunar cycles. We used paired acoustic monitoring devices from November of 2018 to September of 2019 at the San Joaquin Experimental Range in the foothills of the Central Valley to monitor bat activity. We recorded 14,292 calls over our study period. The average number of calls per night were 59 for moonless nights, 62 for full moon, and 154 for half-moon. Similar to previous work in the tropics, bats in our study show elevated echolocation activities during the half moon, presumably as they balance the risks of predation by owls during bright nights with the increased insect prey capture that half-moon nights provide over moonless nights.
**OCCURRENCE OF FISHER (PEKANIA PENNANTI) PREY SPECIES IN A LANDSCAPE ALTERED BY TREE MORTALITY**

Rebecca E Green; PSW Research Station, USDA Forest Service; 54325 McKinley Grove Rd, Shaver Lake, CA, 93664; (559) 841-6318; rebecca.green@usda.gov; Caralie Brewer, Isaac Cortes, Sydney McCluskey, Eric McGregor, Liz Newman, Jeff Pierini, Kathryn Purcell, Austin Rife

The diet of fishers in the southern Sierra Nevada differs from other geographic areas due to the effective absence of two large prey species - snowshoe hare and porcupine. Fisher diet in this region includes small mammals, birds, reptiles, insects, and fruit, with squirrel species appearing to provide a consistently available large source of calories. Extreme drought followed by bark beetle outbreaks led to extensive mortality of pine and fir species in the southern Sierra Nevada between 2015-2018. Tree mortality is predicted to alter habitat suitability for fishers through changes such as loss of rest structures and canopy cover, but prey may also be affected by alterations including loss of cone-producing trees, nest structures, or cover. To better understand the current distribution of mammalian prey important for fisher and identify whether severity of tree mortality influences occupancy of prey species, we conducted surveys within an area occupied by fishers in the Sierra National Forest. During fall of 2018 and 2019, we used remote cameras and novel bait stations to document species occurrence in paired cells (200 m x 200 m) with low (<50%) or high (>50%) tree mortality. We present preliminary results and discuss potential implications for fishers in this area.

*Poster Session*

**A CASE FOR SHINY: INTERACTIVE DATA ANALYSIS**

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Shiny is an R package that makes it easy to build interactive web apps straight from R. You can host standalone apps on a webpage or embed them in R Markdown documents or build dashboards. It is built by the same group that gave us RStudio. With Shiny anyone can build fully interactive data analysis workflows. Domain specific examples include integrated population modeling by the team at SpeedGoat, or Migration Mapper by the team at the University of Wyoming. These applications wrap entire, complex data analysis workflows into a simple user interface. But these apps are possible to build without a team of experts. There are few simple requirements required to build these apps. In this poster I'll explain the steps required to build these apps, and provide a few simple examples at how these apps can benefit you and your organization.

*Poster Session*

**RECENT DYNAMICS AND TRENDS OF LANDBIRD POPULATIONS ON SAIPAN, NORTHERN MARIANAS ISLANDS.**

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The avifauna of Saipan includes several endemic and range-restricted species of conservation concern. Monitoring population trends of these species can help inform their conservation. Here we apply reverse symmetry models to 11 years of mist-netting data from Saipan to estimate adult apparent survival probabilities, recruitment rates, population change, and demographic contributions to population change for five bird species: Rufous fantail and Mariana kingfisher declined, bridled and golden white-eye
exhibited little evidence of trend, and Micronesian myzomela increased over the study period. Survival was the largest contributor to population growth for Mariana kingfisher and golden white-eye; survival and recruitment contributed similarly to population growth for rufous fantail; while population growth of bridled white-eye and Micronesian myzomela was determined largely by recruitment. Hierarchical models applied to two species showed greater temporal than spatial variation in vital rates. Annual variation in vital rates confirmed the importance of survival in explaining population growth, but also showed recruitment to be especially important in driving years of increase. Our results provide new insights into drivers of population change in these species and highlight information gaps, such as a need for understanding seasonal habitat use and the scale and timing of movements.

Poster Session

ASSESSING IMPACTS OF ARTIFICIAL HYDROLOGY, LAND USE AND WATER QUALITY ON AMPHIBIAN OCCUPANCY AT RESTORED WETLANDS IN THE CALIFORNIA CENTRAL VALLEY

Kaitlyn B Hernandez; Department of Wildlife Humboldt State University; 1 Harpst Street, Arcata, CA, 95521; (213) 308-5178; kaitlyn.hernandez@humboldt.edu; Dr. Sharon Kahara

The loss of over 93% of historic wetlands in the California Central Valley primarily to agriculture and water diversions promoted through state policies, has left little viable habitat for wetland dependent species. These losses have led to drastic population declines and extirpations of native herpetofauna. Currently, management efforts to restore wetland habitat within public lands and on private easements have been tailored for waterfowl, and it's assumed that these wetlands provide habitat for herpetofauna, however, the validity of this assumption is not known. The aim of this study is to understand how altered hydrology, surrounding land use and water quality in a fragmented landscape affect herpetofaunal occupancy, dispersal, and phenology. Wetland sites across California's Central Valley will be sampled for frogs and toads with a combination of traditional survey techniques such as visual encounter surveys (VES), auditory surveys, as well as environmental DNA surveys (eDNA). Surveys will be conducted monthly for a year to capture effects over the course of the breeding and non-breeding cycle. Single-season occupancy modelling will be applied to assess and compare relative impacts of environmental factors on occupancy and dispersal dynamics. Identification of key environmental factors can help with managing wetlands for herpetofauna. (Work in Progress)

Poster Session

AREAS OF CONSERVATION EMPHASIS (ACE). UNDERSTANDING THE DISTRIBUTION OF BIODIVERSITY IN CALIFORNIA.

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Areas of Conservation Emphasis (ACE) is an effort by the CDFW Conservation Analysis Unit to understand how biological resources are distributed across the state and provide stakeholders with an easy-to-use map interface reflecting multiple facets of biodiversity to inform conservation planning. Information on Species Richness, Significant Habitats, Connectivity, and Climate Resilience is available through a series of ACE map layers in various levels of detail. Users may click an ACE map unit--hexagon or watershed, to access a table of species observed or modeled. At a coarser scale, ACE indices tell a story of relative biodiversity levels across the landscape. Species distribution models and observation data are aggregated and summarized to produce native, rare, and rarity-weighted (Irreplaceability) species richness scores for each hexagon and watershed. These scores are further generalized into an overall Biodiversity score for each map unit. For users requiring greater detail, a series of maps is available portraying scores
for each constituent taxa--amphibians, birds, reptiles, mammals, fish and plants--for each of the richness metrics. Information-rich ACE maps are organized in a hierarchical manner in the web-based ACE-Viewer so conservation practitioners may choose the category of information and level of detail that best suits their needs.

Poster Session

HABITAT CLASSIFICATION FOR DISAPPEARING BURROWING OWL HABITAT IN SOUTHERN CALIFORNIA

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Population sustainability of the western burrowing owl (Athene cunicularia hypugaea) is uncertain due to habitat loss. As part of an effort to understand long-term habitat loss in Southern California, we are tracking changes over a 5-year period as development rapidly proceeds. Habitat classification was utilized as a tool for translating vegetation types to owl habitat suitability based on our previous research into burrowing owl habitat needs. Our research to date is based on our efforts to create a baseline map of suitable habitat to be compared in later years. This included the development of a vegetation classification, a supervised classification using ERDAS Imagine, and ground-truthing of our supervised classification model. The vegetation classification is important to the final habitat suitability model, which will incorporate additional spatial habitat layers and delineate suitable habitat. We present lessons learned in this multi-year effort to understand a changing environment and its effects on burrowing owls. The results from this study provide valuable information that can be applied to classification studies concerning a broad spectrum of species.

Poster Session

Mapping the Barred Owl Invasion of California

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The listed threatened species Northern Spotted Owl (NSO) is negatively impacted by the recent arrival of the invasive Barred Owl (BDOW). Using GIS to map BDOW invasion over time could assist management efforts related to the invasion and could potentially help with planning in areas of the California Spotted Owl (CSO) where the range is more recently being impacted. I mapped the spread of the BDOW in California between 1978 and 2016 using a database of BDOW presence. The results revealed that BDOW spread increased significantly after 1999 and continues to grow. The mapping results revealed that the entire range of NSO is impacted by BDOW populations and the northern portion of CSO range is impacted. The areas in CSO range that are not impacted by the BDOW have been impacted by wildfires. I mapped wildfires between 1978 and 2017 that were within NSO and CSO range, and spatial patterns revealed a significant impact on NSO and CSO range. The impact from two threats, BDOW and wildfire, to CSO range and habitat could have negative impacts on the population and are an important consideration in the proposed federal listing under the endangered species act.

Poster Session

Are Camera Surveys Enough to Assess Porcupine Populations in Northern California?
In the 1900's, North American porcupine (*Erethizon dorsatum*) was viewed as a serious pest species and population reduction measures were implemented. Overall, these methods were highly successful, and now in many parts of the porcupines range, current population estimates are unknown. In 2015, the California Department of Fish and Wildlife designated porcupine as a Species of Greatest Conservation Need during the state's update of the State Wildlife Action Plan. Since 2015, the Collins Almanor Forest (CAF), an industrial timber forest in Northern California, has been performing year-round baited and unbaited camera surveys, but has never detected a porcupine on their 96,000 acre forest, despite historical occurrences. Porcupine are known to be salt-deficient, so in 2019, the CAF used brine-soaked wood at their camera stations as a porcupine attractant. A standardized grid consisting of 565 units that were 160 acres each was created across the property. In 2019, 73 grids were surveyed, but no porcupines were detected. More surveys are needed to better understand porcupine populations in California. Our study, combined with previous data, suggests porcupine may occur at very low densities or not at all in western Tehama and eastern Plumas counties.

**Poster Session**

**IDENTIFYING INDIVIDUAL CALIFORNIA TIGER SALAMANDERS (AMBYSTOMA CALIFORNIENSE) (CTS) USING PATTERN RECOGNITION SOFTWARE.**

**Brianna C Jones;** East Bay Municipal Utility District; po box 8766, Reno, NV, 89507; (209) 329-4507; wildamarok@gmail.com; James S. Jones

Identifying individual California tiger salamanders (*Ambystoma californiense*) (CTS) normally requires methods that involve mutilation, tail and toe clipping, or insertion of passive integrated transmitter (PIT) tags into the abdominal cavity. These methods can be risky, decreasing an individual's health and survival rate. To reduce these factors, we looked at a method that used the unique color patterns of each CTS to reliably identify individuals. The computer program Interactive Individual Identification System Pattern Plus (I3S+), was used to achieve this. I3S+ was found to successfully identify individual CTS faster and with more ease than the human eye could. I3S+ accomplished this by using the unique spacing, size and shape of each individual's pattern to see how similar the patterns of a CTS are to the other CTS photos in the database. The ability to more accurately identify individuals allows us to help better understand the population dynamics of the CTS, while decreasing the risk and harm to the salamander. Being able to also compare the individuals between ponds that are within close proximity (< 1km) with the I3S would provide more insight into the spatial movements of CTS.

**Poster Session**

**Student Paper**

**RESOURCE SELECTION FUNCTION OF ELK IN NORTHEASTERN NEVADA**

**Meghan P Keating;** University of Nevada, Reno; 1664 N. Virginia St., Reno, NV, 89512; (209) 324-5831; mpkeating@nevada.unr.edu; Madeleine Lohman, Julia C. Brockman, Cody McKee

Elk are an important resource for Nevada given their high hunting value. As their distributions have expanded, landowner concerns over elk-livestock competition and damage to crops have increased. The Nevada Department of Wildlife (hereafter the Department) GPS collared elk throughout the state to better understand elk distribution and to improve herd management. We used locations from elk captured in northeastern Nevada (n=84) to model second order habitat selection per season using logistic regression in a Bayesian framework. We identified covariates of interest including distance to water, distance to roads, landcover type, slope, aspect, elevation, and ruggedness. We used a random forest to identify the most
plausible covariates for the resource selection function and cross-validated the model by removing
individuals. We expected to see an aversion to roads and an attraction to water, and high use of forested
landcover types over barren landcover types. We then tested the model on other elk populations in Nevada
to determine if it could be generalized to predict habitat selection throughout the state. With this
knowledge, the Department can better assess the likelihood of human-wildlife conflicts throughout the
state. This project is a work-in-progress and the analysis will be complete by mid-December.

Poster Session    Student Paper

IMPACT OF A SARCOPTIC MANGE EPIDEMIC ON A POPULATION OF ENDANGERED
SAN JOAQUIN KIT FOXES

Erica C. Kelly; CSU-Stanislaus, Endangered Species Recovery Program; One University Circle, Turlock,
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Deatherage, Jaime L. Rudd, Janet E. Foley, Deana L. Clifford

A demographically robust population of endangered San Joaquin kit foxes (Vulpes macrotis mutica) occurs
in the city of Bakersfield, California. In spring 2013, sarcoptic mange was detected in this population and
the disease quickly spread. We have conducted systematic camera station surveys throughout the city since
2015 to assess the occurrence of mange among kit foxes and the spatial pattern of spread. A grid of 1-km
sq cells was established across the city and the surveys are conducted by operating automated cameras for
7 nights annually in just over 100 cells. Based on these surveys, the number of foxes detected declined
from 129 in 2015 to 43 in 2019, which represents an approximately 67% decrease. These data are
consistent with casual observations, trapping efforts, and reports from the public, all of which also indicate
a substantial decline in the number of foxes in Bakersfield. Healthy foxes are still being observed
throughout the city providing hope that mange will not cause extirpation of this population. Monitoring
will continue in an effort to assess whether the epidemic will terminate as fox densities decline below
some critical threshold, or whether the disease becomes endemic in the population with periodic eruptions.

Poster Session

WIND EFFECTS AROUND WILDLIFE EXCLUSION FENCES: A STUDY COMPARING
POROUS TO SOLID FENCES; HOW THE DESIGN CHOICE MAY AFFECT SPECIES WITH
MOISTURE SENSITIVE SKIN

Eojin Kim; Harvard University; 26 Oxford Street #407, Cambridge, MA, 02138; (248) 925-9537;
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Recent projects have raised the question about whether solid exclusion fence barriers cause problems for
salamanders (or other amphibians). The objective of this study is to test the hypothesis that wind flowing
around solid barriers create turbulent, chaotic, desiccating air currents at ground level from which the
salamanders or amphibians cannot easily extract themselves. Without barriers, terrestrial animals do not
normally experience this intensity and type of air flow in the zone which they occupy. Natural no-slip
conditions at ground level normally leave wind velocities near zero in their zone. Evidence from the
Dexter/Funari 2018 study suggest that these types of air currents do not develop with highly porous
barriers as air can flow-through the porosity-controlled barrier, eliminating the possibility that significant
turbulence or chaotic, circular flow eddies develop. The objective of this research was to study, and
confirm this phenomenon using a Computational Fluid Dynamics (CFD) model. The results show that
solid fences can indeed create chaotic wind flows, secondary flows, and eddy currents which can
significantly degrade the environment near the fence for vulnerable, moisture sensitive animals.

Poster Session    Student Paper
MORPHOLOGY OF THE BARRED OWL (*STRIX VARIA*) IN THE PACIFIC NORTHWEST

**Leo Koerner; OR Coop Fish & Wild Res Unit, Oregon State University; 104 Nash Hall, Corvallis, OR, 97331; (512) 771-1787; koernele@oregonstate.edu; Ryan C. Baumbusch, Katie M. Dugger, J. David Wiens**

The morphology of an organism influences its ecological interactions, with well-documented patterns such as latitudinal gradients in body size (Bergmann's Rule) or reversed sexual size dimorphism in birds of prey, with females being larger than males. Barred owls (*Strix varia*) recently undertook a dramatic range expansion from their historic range in eastern North America, across the continent and along the west coast. We used specimens collected as part of a large-scale removal experiment to test whether barred owls in their new range exhibited a latitudinal gradient in body size or reversed sexual size dimorphism. This study has collected over 2,000 barred owls from three localities in Oregon and Washington. In our preliminary results a multivariate analysis of variance showed significant differences in size between sexes (with females larger than males) and age classes (adults larger than subadults), and some differences between study areas but without a consistent latitudinal gradient. However, a principal component analysis only showed clear differences in size between males and females, and not between age classes or study areas.

**Poster Session**  
**Student Paper**

BAT DIVERSITY AND ACTIVITY PATTERNS IN A HETEROGENEOUS LANDSCAPE

**Glen Logan; Butte College; 3536 Butte Campus Drive, Oroville, CA, 95965; (530) 879-4345; glogan001@student.butte.edu; Angel Puig de Robles, Elena Macias, Jessica Hayes, Kasi D'Aloisio, Shahroukh Mistry**

Butte College in California is located on a 376 ha wildlife refuge that has over three km of riparian habitat, 130 ha of blue oak woodlands, 90 ha of grassland and over 70 ha of developed structures as part of the campus. We examined the diversity and patterns of bat activity in the oak woodlands, riparian and campus habitats. An ultrasonic recorder was placed in each habitat type and rotated every three weeks among five different locations. Additionally, 20 bat houses on campus were continually monitored to measure bat abundance. Initial analysis of the acoustic data suggests at least 12 species are present in the refuge with distinct habitat preferences. *Tadarida brasiliensis* was most common in the Oak and Campus habitats while *Myotis californicus* and *M. yumanensis* dominated the Riparian habitat. Significant activity of *Lasiurus noctivagans* and *L. cinereus* were also observed in the Oak and Campus areas. All 20 boxes showed some utilization with six exhibiting persistent use by bats with 100-250 average weekly guano droppings. Season analysis suggests that peak activity for bats in during June-July and bats are present throughout the year. We plan to continue long-term data collection to better elucidate activity and seasonality patterns.

**Poster Session**  
**Student Paper**

INTERACTION BETWEEN SALT MARSH PHYSICAL CHARACTERISTICS AND THE RODENT COMMUNITY IN A SOUTHERN CALIFORNIA TIDAL MARSH

**Kyra L MacFarlane; California State University; 2842 East 4th Street, Long Beach, CA, 90814; (704) 661-7578; kmacfarlane94@gmail.com; Christine, Whitcraft**

While many aspects of marsh ecology have been extensively studied, little is known about rodents within...
southern California tidal salt marshes. Like wetlands connect terrestrial, marine, and freshwater systems, rodents connect terrestrial and aquatic ecosystems as foragers in the marsh and as an important food source for higher trophic carnivores; however, little is known about their community composition or spatial distribution. To remedy this, I am assessing (1) rodent distribution along an elevation gradient, and (2) community composition at two sites with differing upland habitat connectivity. Rodent live trapping was conducted for two seasons - summer and fall 2019 at Seal Beach National Wildlife Refuge, Seal Beach, California. In total, 59 rodents (36 Mus musculus, 21 Reithrodontomys megalotis limicola, 2 Peromyscus maniculatus, 2 Rattus rattus) have been captured with successful captures 136 times of 2,219 trap nights. In fall, the number of new rodents has decreased from summer, and nearly all rodents have been recaptured individuals (identified via ear tag). In summer, there were minimal differences in per transect abundance between tide level and site, potentially due to overall low abundances. In fall, fewer animals have been caught in low marsh during high tides. This project is ongoing.

COMING OR GOING: TIDALLY INFLUENCED HABITAT SELECTION OF SHOREBIRDS AND WATERFOWL ON HUMBOLDT BAY

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This study examines how shorebird and waterfowl habitat selection is influenced by the tidal cycles in Humboldt Bay, California. I study how resident and migrating shorebird and waterfowl species are distributed on the Humboldt Bay during four types of tidal events; low, mid to high, high, and high to low tides. The Humboldt Bay, located along the Pacific flyway, serves as an important stop over site for many species of migrating birds. Thus, as migration occurs, competition for resources heightens as migrating populations arrive. Previous research shows that tide height influences the partitioning of shorebird species during feeding events. In addition, studies have found that various waterfowl species prefer specific water depths when feeding. Preliminary results align with these findings, however there is a distinct habitat overlap of shorebirds and waterfowl species during mid-tidal events. During this event, tidal sloughs and mudflats are exposed, offering ample foraging opportunities for both shorebirds and waterfowl.

IDENTIFYING ROCKY MOUNTAIN ELK CALVING AREAS ON THE PLUMAS NATIONAL FOREST IN NORTHEASTERN CALIFORNIA

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Sustainable elk habitat and domestic grazing management on US Forest Service lands involves a complex relationship between management practices and ecological processes. A relatively novel Rocky Mountain Elk population (Cervus elaphus nelsoni) on the Plumas National Forest (PNF) in northeastern California became established in the early 2000s, but there is little information on the current number of individuals or the land use extent of elk on the PNF. Elk populations are highly influenced by cow and calf survival and disturbances during the calving period are associated with reduced calf:cow ratios. Taking advantage of the fact that cows and calves have limited mobility during the first few weeks after birth, I developed a survey method that can be utilized by the PNF to identify and conserve key areas where calving activity occurs. Vegetative conditions and management histories will be documented for positively identified calving areas on two scales to begin gathering data related to site selection. The monitoring program will enhance the USFS's ability to manage elk habitat, as well as resources for the threatened gray wolf, and domestic grazing on the PNF. The information will also benefit collaboration with partners as part of
multi-stakeholder adaptive management effort. (Note: This is a graduate capstone project as part of Oregon State University's Masters of Natural Resources program, done in partnership with the Plumas National Forest. Surveys are planned to be incorporated into the PNF's program of work starting 2020).

**CHANGES IN THE CALIFORNIA LEAST TERN DIET THROUGHOUT THE BREEDING SEASON AT THE SEAL BEACH NATIONAL WILDLIFE REFUGE**

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The California Least Tern (CLT: _Sternula antillarum browni_) is a state and federally endangered seabird that nest in colonies on sandy beaches in California and Baja California each year. As a result of habitat loss and degradation, population numbers have been in decline. One important factor believed to contribute to influencing healthy population numbers is change in preferred prey throughout the breeding season. Quantifying available prey in habitats near established colonies and prey consumed throughout three stages (egg, chick, and fledgling) in the breeding season will aid in understanding the shift in prey. Using seines, we surveyed prey availability at various habitats around the colony within Seal Beach National Wildlife Refuge in southern California. Preliminary data show differences in prey availability throughout the season that corresponds to reproductive stages of the fish with more gobies and topsmelt in the fledging than the egg stage. Although topsmelt dominate samples from all seasons, guano samples show differences between the chick stage versus the egg and fledgling stages; potentially driven by increased Fundulus in the chick stage. Information like this can help inform management by indicating when prey availability may be a factor in the overall success or failure of a CLT colony.

**ROOST SELECTION IN SPOTTED OWLS ACROSS ELEVATIONAL GRADIENT: PRELIMINARY RESULTS**

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Many old-growth forest species in western North America select multi-layered tree stands to maintain thermoneutrality and buffer themselves from variable weather. These species are potentially vulnerable to warming climate conditions, particularly in conjunction with the loss of older forest cover. The spotted owl uses older-forest and is apparently cold-adapted because of its dense plumage and limited ability to dissipate heat. During July 2019, we used GPS-tagging and doubly-labeled water injections on male and female breeders at low and high elevations to 1) examine microhabitat selection as a potential buffer to hot summer temperatures and 2) measure the effect of ambient temperature on field metabolic rates. Individuals at low elevations experienced temperatures that approached upper tolerance limits and were representative of temperatures predicted by climate models for higher elevations by end-of-century. Individuals selected roost sites in stands with cooler microclimates than other available stands regardless of elevation, yet the strength of selection for cooler forest stands was unexpectedly weaker at lower elevations. These data will guide our future research on the effects of ambient temperature on habitat selection and resting and moving field metabolic rates, which will help elucidate potential effects of climate change on this indicator species.
POLARIZED LIGHT PRODUCED BY UTILITY-SCALE SOLAR FACILITIES MAY ATTRACT AQUATIC INSECTS;

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Efforts to impede global climate change and meet the required reduction of greenhouse gases to below 1990 levels has caused energy generation and consumption to shift exponentially towards renewable energy sources. Utility-scale solar facilities are the fastest growing source of energy production. However, solar facilities require vast amounts of land for development, inevitably altering local landscapes and ecosystems. It is still unclear how utility-scale solar facilities will impact local environments and ecology. A review of the current available literature indicates that polarized light pollution produced from photovoltaic panels is disruptive to avian species as well as flying insects. The purpose of this study is to determine insect behavioral response to polarized light pollution from utility-scale solar facilities by comparing insect abundance and species composition within a utility-scale solar farm to insect abundance and species composition at a control site outside the same solar farm.

Poster Session  Student Paper

USE OF DNA SEQUENCING TO IDENTIFY THE ORIGIN OF NORTHWESTERN AND SOUTHWESTERN POND TURTLES IN CAPTIVE BREEDING PROGRAMS

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Captive breeding is a critical management strategy in the recovery and preservation of certain threatened and endangered species. In this study, I worked in collaboration with 24 zoos, museums, and aquaria to aid in conservation of threatened and endangered freshwater turtle species through captive breeding. The Northwestern (Actinemys marmorata) and Southwestern Pond Turtle (Actinemys pallida) are the only two extant freshwater turtles that are native to California and are threatened throughout their entire native range. As individuals of the two different species can appear morphologically identical, we used DNA sequencing to identify wild-bred members of Actinemys marmorata and Actinemys pallida to build captive brood stock of both species. Relatively few studies have designed conservation efforts around two genetically distinct species within the genus Actinemys as the majority of research on this clade was done before the discovery of a second species. Here, I analyzed the nicotinamide adenine dehydrogenase subunit four (ND4) mitochondrial gene to identify species and geographic origin for 133 captive pond turtles. Results of this study were used to inform captive breeding program collaborators so that husbandry is managed in consideration of species, geographic origin, and the subsequent risks of outbreeding and inbreeding depression.

Poster Session  Student Paper

OF MEADOWS AND MARMOTS: AN INVESTIGATION OF CLIMATE CHANGE IMPACTS ON THE DECLINING ENDEMIC OLYMPIC MARMOT (MARMOTA OLYMPUS) POPULATION

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Habitat connectivity is essential for organism survival. Climate change, land use/cover change and habitat fragmentation/loss are threatening wildlife habitat connectivity. The Olympic marmot's high alpine habitat is at risk of losing important connectivity due to climate change impacts such as tree encroachment. The endemic Olympic marmot population of Olympic National Park (ONP) has declined an estimated 50% in
the past 30 years (Griffin, 2008). The Olympic marmot is an ecologically important and charismatic species. The goal of this project is to learn more about climate change impacts on alpine meadows, marmot habitat preferences and habitat connectivity as a potential driver of marmot population decline. Occupancy rates of each meadow unit surveyed were obtained by gathering geospatial data collected from a randomly selected marmot habitat polygons. Metrics of landscape connectivity across the study area were obtained using Conefor 2.6 and ArcGIS. We found that connectivity was lower in areas of low marmot occupancy and higher in areas of higher marmot occupancy, confirming the hypothesis that landscape connectivity would be higher in areas of higher marmot occupancy. This information is being disseminated to ONP managers to help develop management strategies to aid in the future preservation of the species. (Work-in-progress)

Poster Session  Student Paper

ESTIMATING SPACE SHARING BETWEEN SEABIRD, PINNIPED, AND HUMAN USE IN THE NORTHERN CALIFORNIA COAST

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Rocky coastlines incur high impacts from human use, but these places are also essential habitat for marine wildlife including seabirds and pinnipeds for breeding, resting, and social interaction. The potential of spatial and temporal overlap between humans and marine wildlife could lead to high risk of disturbance events. I investigated the relative risk of disturbance to eight species of marine wildlife from varying types of human use to inform science-based cooperative management in areas where humans and wildlife overlap. I estimated space sharing between marine wildlife and human use using spatial overlap methods, specifically using the volume of intersection (VI) test statistic in Trinidad, California. Results of this project identified areas of varying levels of spatial overlap between seabirds, pinnipeds and varying types of human use (including consumptive and motorized activities). The species exhibiting the most space sharing with human use were Western Gulls with a VI score of .741 +/- .058, while the least amount was Steller Sea Lions with a VI score of .0283 +/- .0016. This project provided an assessment of the volume of intersection index as a spatial tool for identifying specific user groups for education, disturbance risk assessment, outreach and enforcement for marine wildlife protection.

Poster Session  Student Paper

PHYLOGEOGRAPHIC ORIGIN OF CALIFORNIA SLENDER SALAMANDERS (BATRACHOSEPS ATTENUATUS) IN THE SUTTER BUTTES

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The phylogeny of California Slender Salamanders (Batrachoseps attenuatus), which inhabit Northern California’s Coast Ranges and Sierra Nevada foothills, was previously investigated by Martinez-Solano et al. (2007) who recovered a monophyletic species that contained five geographically cohesive major clades. However, a population isolate of B. attenuatus found in the Sutter Buttes, a geographically isolated volcanic mountain range within the Sacramento Valley, was not included in their phylogenic analysis. We sequenced ~780 base pair segment of the mtDNA cytochrome b (cytb) gene used in Martinez-Solano et al. (2007) to examine the phylogenic placement of this isolated population within the B. attenuatus complex. Our results, based on a single mitochondrial marker, indicate that the Sutter Buttes population of B. attenuatus is a well-supported monophyletic group nested within the Sierran segment of the "East Bay / Sierra" Martinez-Solano et al. (2007) subclade, which is in turn nested within their "Eastern" major clade. Although we cannot accurately estimate how long the Sutter Buttes population has been isolated, B.
attenuatus was likely able to colonize the Sutter Buttes during pluvial Pleistocene interglacials when more contiguous woodlands may have opened dispersal corridors across the Great Central Valley.

**Poster Session**

**QUANTIFYING MOTH COMMUNITY RESPONSE TO FIRE IN A CALIFORNIA CHAPARRAL SYSTEM**

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Anthropogenic climate change has led to an increase in wildfire intensity in many areas of the world, and global climate models predict this trend to continue. Plant succession after fire has been documented, but there is a need to study how animals respond to these changes in plant communities. In terrestrial habitats, lepidopterans (i.e. moths and butterflies) are studied as bioindicators of ecosystem health based on four criteria: (i) their well-defined taxonomy, (ii) the relative ease of surveying them, (iii) their host-plant specificity, and (iv) their concordance of diversity with that of other taxonomic groups. Further, the order Lepidoptera contains more plant-feeding species than any other North American taxon. I am evaluating the hypothesis that changes in moth communities parallel those in plant communities following fire. To do this, I am utilizing ten 15W UV blacklight traps to collect moths on a 24-hectare area of chaparral affected by a 2017 wildfire and two otherwise similar reference sites at the Big Chico Creek Ecological Preserve. Preliminary data suggests a difference in species abundance and species richness between the sites. Further examination may indicate a change in proportions of specialist to generalist feeding behavior and family-level differences in response to fire.

**Poster Session**

**LESSONS LEARNED FROM ESTABLISHING A BURROWING OWL BREEDING NODE IN SAN DIEGO COUNTY**

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Population sustainability of the western burrowing owl (Athene cunicularia hypugaea, BUOW) is uncertain due to habitat loss, which is especially acute from expanding development in San Diego County. Multiple agencies have increased efforts to create suitable BUOW habitat and new breeding nodes in San Diego County to help stabilize the population. At Rancho Jamul Ecological Reserve (RJER), the California Department of Fish and Wildlife established a Burrowing Owl Habitat Management Area. In 2018, the first steps were taken to establish a new BUOW breeding node there, with ten BUOW relocated. In 2019, nine BUOW that were anticipated to be impacted by construction activities at the U.S.-Mexico border fence and two individuals from the conservation breeding program at the San Diego Zoo Safari Park were translocated to RJER. After a soft-release period, they continued to be monitored through site visits, camera traps, and satellite telemetry. We used techniques such as artificial conspecific cues (e.g. call playback), predator training, and supplemental feeding to dampen dispersal and increase juvenile survival. This effort adds to our understanding of active translocation as a tool for both conservation and mitigation. We present lessons learned in the second year of this multi-year effort to establish a new subpopulation of BUOW.

**Poster Session**
California ground squirrels (*Otospermophilus beechyi*) are essential engineers of subterranean habitat that many species rely upon, including sensitive and listed species such as the California tiger salamander (*Ambystoma californiense*) (Barry and Shaffer, 1994, Storer, 1925). Their presence in a heavily urbanized matrix makes them welcome neighbors for these species and, at the same time, a nuisance for humans and human-made structures. We seek to understand the distribution of California ground squirrels on Stanford property to determine where concentrations of ground squirrels are located, how they are distributed in relation to humans and human-made structures, and in what way their colonies overlap with restored salamander habitat. The findings of this study will be used to inform management of California tiger salamanders and other special status species including western burrowing owls as well as gain a better understanding of where ground squirrels fit in the matrix of heavily developed land.

**Poster Session**

**IMPROVING CDFW'S CAPACITY TO SUPPORT ADAPTIVE MANAGEMENT BY MEASURING AND SHARING ITS PROGRESS ON CALIFORNIA STATE WILDLIFE ACTION PLAN IMPLEMENTATION**

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A core tenet of ecosystem-based management (EBM) is the ongoing adaptation of management plans, in response to changing conditions and experience. Therefore, successful implementation of landscape-scale EBM plans, such as the California Department of Fish and Wildlife's (CDFW) California State Wildlife Action Plan (SWAP), requires practitioners to collect and interpret monitoring data to evaluate the statuses of species of concern; habitat suitability and function; and whether management actions are achieving desired outcomes. Thus, CDFW's Science Institute (SI) is collaborating internally with CDFW programs to quantify the Department's progress towards fulfilling SWAP initiatives, and to ensure that relevant monitoring data are gathered and reviewed, with results communicated effectively. To that end, SI is working with CDFW grant managers to identify monitoring needs and to extract monitoring data produced by grantees. These data will be compiled in a database to facilitate their review, as well as outcome reporting. Furthermore, SI and CDFW grant managers are updating grant applications to include SWAP-specific questions and exploring creative methods for obtaining monitoring information when it is otherwise lacking, in order to best establish and share CDFW's conservation successes and lessons learned. Results of these efforts will inform future management plans, including the 2025 SWAP update.

**Poster Session**

**REDUCING THE IMPACT OF COMMON RAVENS ON GREATER SAGE-GROUSE THROUGH EGG-OILING**

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The common raven (*Corvus corax*) population of western North America has increased concomitantly with greater sage-grouse (*Centrocercus urophasianus*) population declines. Ravens now are an important nest predator of sage-grouse. Managed reduction of raven nest success could ameliorate raven effects on
nesting grouse if raven foraging is suppressed due to nest failure relative to breeding ravens that are provisioning chicks. We hypothesize that reducing raven reproductive success through egg-oiling treatments, which causes eggs to become inviable, will improve sage-grouse nest survival. Additionally, we measured incubation patterns of ravens to identify impacts of egg-oiling on incubation recesses, constancy, and duration. In 2019, we oiled raven eggs at two treatment sites, and did not oil eggs at four control sites as part of a before-after-control-impact experimental design, with sage-grouse nest survival estimated at all sites for three years before initiation of treatments. Preliminary results indicate an average increase in sage-grouse nest survival by approximately 21% at treatment sites while control sites either declined in survival or did not change. Results will be used to develop management actions for reducing the impact of ravens on sage-grouse and other sensitive prey. Findings are preliminary and provided to meet the need for timely best science.

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

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Spatial capture-recapture (SCR) models are widely used and have become the standard for robust estimation of abundance and density for wild populations. SCR modeling frameworks explicitly account for spatial variation in detection probability and density and are robust to violation of assumptions of geographic closure. Simulation-based studies have explored the performance of SCR in the context of trap configuration and sampling effort, but the body of work exploring behavior of SCR models with empirical data is limited. When sampling populations for the purpose of implementing SCR, resulting sample sizes (e.g., number of unique individuals detected) can be highly variable. Using a multi-site, multi-year black bear capture-recapture dataset, we evaluated the uncertainty of SCR structural parameter estimates, specifically density, detection, and the spatial scale parameter sigma in the context of sample size outcomes. A higher ratio of recaptures and spatial recaptures to unique individuals detected reduced uncertainty of density estimates. A high number of recaptures at the same trap led to precise but very small sigma estimates, resulting in density estimates that were unrealistically high, suggesting a positive bias. We recommend closely evaluating sampling outcomes before implementing SCR to detect sampling issues that could result in imprecise and potentially biased estimates.

SAN FRANCISCO URBAN COYOTE REPOPULATION: A NONINVASIVE GENETIC PERSPECTIVE

Monica Serrano; Mammalian Ecology and Conservation Unit, VGL; School of Veterinary Medicine, UC Davis, Davis, CA, 95616; (559) 595-4061; mgserrano@ucdavis.edu; Julia Owen, Sophie Preckler-Quisquater, Stevi Vanderzwan, Ben Sacks

Mesocarnivores inhabiting urban settings is becoming more frequent throughout the United States due to a reduction of natural habitats. Coyotes (Canis latrans) are mesocarnivore generalists that readily acclimate to available resources which allows them to exploit urban settings. Urban colonization by coyotes in the San Francisco area has been documented since the early 2000s after their extirpation from the city in the 1920s. Using genetic testing, it was found that the first collared male in San Francisco likely immigrated from Marin County by crossing the Golden Gate Bridge. The number of individuals within the county of
San Francisco and whether they are interrelated remains unknown. From 2015 until present, 90 scat samples were noninvasively collected from various locations in San Francisco by citizen scientists. Here we used genetic analysis of these samples to provide estimates of sex ratios, relative number of individuals, and genetic diversity present within this urban coyote population. Understanding these population characteristics will facilitate better management of urban coyotes on an individual and group basis.

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**BAT BIODIVERSITY WITHIN SEQUOIA AND KING'S CANYON NATIONAL PARKS**

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Insectivorous bats are important components of North American ecosystems that contribute to nutrient cycling and provide ecosystem services to humans. Despite their importance, not much is known about basic bat biogeography, especially in protected areas such as National Parks. We focus on bat biodiversity of Sequoia and Kings Canyon National Parks (SEKI). Currently, the only extensive records of bat biogeography in SEKI consist of acoustic monitoring and mist-netting efforts conducted between 2001-2006 by Pierson and Rainey (2017) and a handful of our acoustic monitoring and mist-netting events conducted during the summers of 2018 and 2019. In May 2019, we deployed ultrasonic recorders at four sites within SEKI. These four sites represent different ecosystem types, have associated weather recording stations, and historically high species diversity indicated by Pierson and Rainey (2017). Initial results reveal an average of between 8 and 50 echolocations per night across our four sites, and mean species richness of between 2 and 7 species per night. Highest biodiversity during summer occurs at mid-elevation sites near Cedar Grove. Heterogeneity within and among sites speaks to highly variable acoustic biodiversity sampling results and the need for long-term monitoring projects to accurately assess bat biodiversity.

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**TRAPPED: A SWIFT STORY**

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The radar tower on Mount Umunhum is a remnant of the former Almaden Air Force Station and is currently owned by Midpeninsula Regional Open Space District (Midpen). In 2015 Midpen sealed openings on the concrete structure to address vandalism and public safety, however this created an unintended wildlife entrapment issue. From 2016-2018, 100+ dead and 50+ live white-throated swift (Aeronautes saxatalis) were found trapped within the tower with no clear route of entry. Adults and hatch year juveniles were found but evidence of breeding was not. Entrapment peaked in July and cause of death was starvation. Midpen worked diligently to solve the issue by: sealing all entrances using various materials, testing one-way door escape points, wildlife camera monitoring, marking birds, and transporting swifts to rescue facilities. In July 2018 the entrance point was discovered as a small crack on the exterior wall providing access to a single pipe which released inside the tower. Midpen staff sealed this pipe and swift entrapment finally ceased. Data suggests the tower may have historically served as a post-breeding roost for swifts which are not a special status species however, is protected by the federal Migratory Bird Treaty Act and California Fish and Game Code.
IDENTIFICATION AND QUANTIFICATION OF BARRED OWL (*STRIX VARIA*) INTESTINAL PARASITES IN THE PACIFIC NORTHWEST

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The westward expansion of barred owls (*Strix varia*) and their recent replacement of northern spotted owls (*Strix occidentalis caurina*) in forested habitats may alter predator-prey dynamics in the Pacific Northwest. Diet composition of barred owls in Oregon and Washington is much broader than the diet of spotted owls and includes numerous invertebrate prey such as snails and insects. This broader diet may expose barred owls to new parasites and alter parasite-host dynamics in the Pacific Northwest. We necropsied 1,329 barred owls collected as part of a removal experiment over three years from three separate study areas in Washington and Oregon. Preliminary results from gross examination of body cavities of dissected barred owls showed that 7% of individuals are infected with a parasite. Currently, we are examining the intestinal contents of a subset of owls collected to 1) identify which helminth parasites infect barred owls in these areas, 2) estimate prevalence of these parasites across these populations, and 3) estimate the load of parasites within infected individuals.

SECURING CALIFORNIA'S NATURAL HERITAGE: THE CALIFORNIA BIODIVERSITY INITIATIVE

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In 2018, Governor Brown issued the California Biodiversity Initiative, in an effort to improve understanding of California's biodiversity and to identify actions to preserve, manage, and restore ecosystems to protect this biodiversity from climate change. The Biodiversity Initiative generally seeks to promote a deeper understanding of the threats to California's biodiversity, protect native vegetation, manage and restore natural and working lands and waterways, and explore appropriate financing options to achieve these goals. Focal areas of the Biodiversity Initiative align with several of the Aichi Biodiversity Targets adopted by the Parties to the Convention on Biological Diversity in 2010. While all state agencies are to work together to achieve the goals of the Biodiversity Initiative, the California Department of Fish and Wildlife is launching the Biodiversity Initiative via efforts through its Science Institute, Biogeographic Data Branch, and Invasive Species Program. These efforts include hiring of a Biodiversity Coordinator to support implementation of the Biodiversity Initiative, updating an atlas of the biodiversity of California, integrating biodiversity conservation with transportation and infrastructure planning, surveying and mapping California's natural vegetation, and tackling the threat imposed by nutria (*Myocastor coypus*).

PREY SHARING BETWEEN BARRED OWLS (*STRIX VARIA*) IN OREGON AND WASHINGTON

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The northern spotted owl (*Strix occidentalis caurina*) was listed as threatened under the Endangered Species Act in 1990 and has been the subject of intensive conservation and management efforts since. An area of particular concern is the recent range expansion of the barred owl (*Strix varia*), which now overlaps the entire range of the northern spotted owl and occurs at high densities in some areas. Competition with barred owls is associated with continued population declines of northern spotted owls despite widespread habitat conservation. In 2015, experimental barred owl removals were initiated in Washington and Oregon, to evaluate if barred owl removal is an effective option for northern spotted owl conservation. The removal study presents a unique opportunity to investigate barred owl diets and foraging behavior. In particular, we were interested in investigating whether barred owl pairs preyed on similar species. To address this question, we necropsied 233 barred owl collected as pairs and analyzed their stomach contents. Preliminary results show a low occurrence of prey sharing, with 3% of pairs appearing to have shared the same prey item. However, 41% of pairs collected together had at least one prey taxon in their stomachs common to both individuals.

**LANDSCAPE ANALYSIS OF HEMORRHAGIC DISEASE EXPOSURE IN SOUTHERN MULE DEER**

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Disease can play a major role in shaping wildlife populations, and changing ecosystems and landscape attributes can significantly influence risk of exposure in these populations. In the U.S., there are three hemorrhagic diseases that affect wild ungulate populations; Adenovirus Hemorrhagic disease (AHD), Bluetongue (BTV), and Epizootic Hemorrhagic disease (EHDV). BTV and EHDV are spread through a vector of the *Culicoides* genus while AHD is spread through direct transmission. However, the epidemiology of these diseases is largely unknown in wild populations. The Southern Mule Deer (*Odocoileus hemionus fuliginatus*) in Southern California, is a subspecies of conservation concern with the potential to be exposed, though the prevalence of exposure and record of outbreaks are unreported and unknown. We explored the distribution and co-occurrence of AHD, BTV, and EHDV, as well as their relationship with landscape variables based on seroprevalence in 100 mule deer in San Diego County. Our results suggest that presence of livestock may affect the health and disease status of Southern Mule Deer. Monitoring of these hemorrhagic diseases in areas where cattle and deer are in close proximity, and the careful management of grazing may be necessary to conserve and protect this subspecies from outbreaks of hemorrhagic diseases.

**SUMMER HABITAT USED BY AMERICAN KESTRELS IN SANTA CLARA COUNTY, CALIFORNIA**

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Urbanization causes declines in many wildlife populations and the loss of native species through habitat loss, fragmentation and land conversion (Tilman et al., 2001; Krauss et al., 2010; Marzluff, 2001). Birds of prey, which are mid- or top carnivores, are especially at risk from the loss of habitat that can occur on both
the breeding and wintering grounds. Raptors can be considered environmental indicators of habitat degradation because of their small populations, low population densities, and high position in local food webs. This research investigated the habitat preference of the American Kestrel (*Falco sparverius*) (kestrel), a widely distributed raptor, whose populations have been declining in the U.S. and may be declining in Santa Clara County in northern California. The land cover types and habitat features with which kestrels associated were identified by collecting in-situ records of habitat features and conducting point counts of kestrels. Results showed an association between kestrel presence with grassland and pasture/hay land cover, especially in open space conditions, indicating that conservation of these habitats could help protect American kestrel populations. Installing kestrel nest boxes in grassland and pasture/hay conditions with strategic monitoring of reproduction may benefit populations in this region.

*Poster Session*

**USING SINGLE-SEASON SPECIES CO-OCCURRENCE MODELS TO TEASE OUT IMPORTANT FACTORS DRIVING CONDITIONAL OCCUPANCY**

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We are interested in how a healthy community of carnivores are able to co-exist across multiple jurisdictions of open space in Marin County, California. We used a 3-year dataset from a large-scale (32 sq km) 127 camera trap grid to investigate factors that combines both covariates of disturbance on the landscape with species-co occurrence in a relatively novel occupancy framework. We focused on three carnivore species: bobcat (*Lynx rufus*), coyote (*Canis latrans*) and grey fox (*Urocyon cinereoargentius*). Preliminary results suggest that features in the environment may be more important than human-related variables in shaping conditional carnivore co-occurrence . We present our findings illustrating how these three species may not be driven as clearly by competitive exclusion but rather by other extrinsic factors (this is a work in progress).

*Poster Session*  

**DESIGN OF A PASSIVE DEVICE TO SIMULTANEOUSLY MARK AND COLLECT NON-INVASIVE GENETIC SAMPLES FROM TREE SQUIRRELS**

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Tree squirrels (*Sciurus* sp.) are among the most commonly encountered wildlife in urban areas of the United States. Despite their ubiquity, little is known about the tree squirrels in San Jose, California. Two non-native squirrels, the Eastern Grey Squirrel (*S. carolinensis*) and Eastern Fox Squirrel (*S. niger*), were introduced to the San Francisco Bay Area roughly a century ago. The only native species, the Western Grey Squirrel (*S. griseus*), appears to be absent from urban areas. In the summer of 2019, we developed and tested a system to passively mark squirrels with non-toxic, non-permanent paint for visual tracking and mark-recapture, while simultaneously collecting high quality hair samples for genetic analyses. The trap, constructed out of simple and cost-effective materials, enables scalable deployment while eliminating direct contact between researchers and wildlife. We present our trap design and preliminary survey results from fall and winter 2019. Future and ongoing research will implement this design to 1) document the presence of each squirrel species, 2) assess the degree of overlap between the three species, and 3) investigate how land use and urban density affect movement and connectivity among squirrel populations throughout San Jose and surrounding areas.

This paper is a work in progress.
**CALIFORNIA RED-LEGGED FROG RESPONSE TO POND RESTORATION**

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The California Red-legged Frog (*Rana draytonii*) is federally listed as threatened. Habitat alteration is a significant contributing factor in their decline. Pond restoration and enhancement efforts are tools that can reverse this trend by improving habitat conditions that support recovery goals for the species. We removed excess sediment and emergent vegetation at the Garin Newt Pond Wildlife Area in central California to determine if these actions benefited this species. After sediment removal in 2017, the hydroperiod of the pond improved resulting in California Red-legged Frog egg masses and tadpoles increasing by 99% and 97%, respectively, compared to 2008 - 2016. We also found significant increases in number of adult and larvae sampled pre-restoration (2008 to 2017) and post-restoration (2018 to 2019). This new site-specific information on California Red-legged Frog response to pond hydroperiod improvements in a central California rangeland may assist recovery efforts designed to preserve and manage habitat for this threatened species.

**AMERICAN BULLFROG; GUIDANCE FOR THE CONTROL AND MANAGEMENT OF THIS INVASIVE NON-NATIVE PREDATOR**

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The American bullfrog (*Ranidae: Lithobates catesbeiana*), native to eastern North America, is considered one of the top 100 worst global invasive non-native species. They predate upon a suite of native species and are implicated in the decline of native amphibian species throughout western North America, including several threatened or endangered ranid species in California. The California Department of Fish and Wildlife (CDFW) is developing scientifically based guidance for CDFW staff, consultants, agencies, and others who manage aquatic environments. The guidance will include practical applications for management of American bullfrog habitat and population control or eradication targeting their life stages. Specific management tools for removal, as well as permitting pathways, will be addressed. This effort is the result of collaboration between federal and state agencies, universities, museums, and stakeholders. We seek your input and experience with American bullfrog control as we move forward with developing and implementing the guidance.

**THE INFLUENCE OF HUMAN DISTURBANCE ON THE COUPLED DYNAMICS OF PREDATORS AND PREY**

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The rapid expansion of human activity in the Anthropocene has broadly influenced the distribution and behavior of wildlife. Many studies have found that humans can displace animals in space and time and, alternatively, that animals can habituate or be attracted to humans in space and time. However, fewer studies have examined the consequences of human activity on coupled species interactions. Here we
present a systematic review of studies that measured both mammalian predator and prey response to human disturbance (human activity, infrastructure, roads, and direct habitat modification) (N=47). We discuss trends across taxa pairs and how spatial responses of predators and prey may be altered by the co-occurrence of hunting, resource provisioning, or domestic pets at disturbance sites. Our review indicates that method of inference and scale can largely influence the results of human impact studies on mammal predator-prey pairs. By understanding the circumstances in which predators or prey respond positively, negatively, or neutrally to various types of human disturbance, we can better anticipate when decoupled or enhanced predation will result in changes in interaction strength and altered patterns of energy intake within ecological communities.

Poster Session

EFFECT OF ENVIRONMENTAL VARIATION ON ECOLOGICAL ATTRIBUTES OF ENDANGERED SAN JOAQUIN KIT FOXES

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Environmental conditions in arid habitats are strongly influenced by annual precipitation and thus can vary markedly among years. We assessed foraging patterns and space use by endangered San Joaquin kit foxes (*Vulpes macrotis mutica*) on the Carrizo Plain National Monument in central California in 2015-16, at the end of a 5-year period of below average precipitation, and again in 2017-18 after conditions improved in response to above average precipitation. Prey availability indices increased markedly between the two periods, and predation of kangaroo rats by kit foxes exhibited a concomitant increase as well. In response, 95% Minimum Convex Polygon (MCP) home ranges and 50% MCP core areas decreased dramatically from means of 4.2 km sq and 1.3 km sq in 2015-16 to means of 1.3 km sq and 0.4 km sq in 2017-18. Reduced space use in association with increased food availability potentially could increase survival probabilities through reduced exposure to larger predators and also could increase reproductive success of kit foxes, both of which would result in an increase in kit fox abundance. Consistent with this prediction, kit fox numbers increased substantially from 2015 to 2019 based on standardized spotlight counts conducted by the California Department of Fish and Wildlife.

Poster Session

TEMPERATURE LOGGERS EFFECTIVELY MONITOR SHOREBIRD NEST SURVIVAL

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Nest survival studies have greatly increased knowledge of avian ecology. However, traditional methods require regular revisits to the nest, which requires substantial effort and may impact the parameters being measured. As part of ongoing work to test the efficacy of methods to reduce fieldwork and increase accuracy and precision, we monitored shorebird nests in Arctic National Wildlife Refuge with temperature loggers and revisits and examined the effectiveness of these methods. Temperature data revealed whether the nest hatched or failed, specific times of hatching and chicks leaving the bowl, and incubation behavior. Three reviewers independently agreed on the nest fate derived from temperature loggers >90% of the time. For Pectoral Sandpipers, there was little difference in daily nest survival between nests with a high and low frequency of visits. Our results show remote monitoring techniques may provide more consistent, accurate, and precise data on fate and behavior than is possible with revisits alone, although more research on effects will be required.

Poster Session

Student Paper
HABITAT USE OF HAWAIIAN SHORT-EARED OWLS

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Species adopt different habitat use strategies throughout their range as a mechanism to persist in different environments. Short-eared Owls are typically considered extremely nomadic grassland specialists throughout much of their range in temperate and continental systems. In Hawai'i however, Hawaiian Short-eared Owls (Pueo: Asio flammeus sandwichensis) inhabit an extremely different ecosystem composed of isolated tropical islands. Lacking drastic seasonality, interspecific competition, and vast continental landscapes we hypothesize that Pueo will tend to exhibit higher site fidelity, fewer nomadic movements, and utilize a broader range of habitat types than their continental and temperate counterparts. Understanding habitat use patterns across the range of environment conditions that Short-eared Owls inhabit is important to informing successful conservation practices that contribute to the sustainability of the species. In this study we have deployed two VHF transmitters on a Pueo pair from the island of O'ahu so far with ongoing efforts to tag more. Tracking the owls movements will allow us to identify habitat use and movement patterns in Hawai'i. This paper is a work in progress.

CHANGES IN BAT BIODIVERSITY FROM 2001-2006 TO 2019 IN SEQUOIA AND KINGS CANYON NATIONAL PARKS

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We made use of a published report from Pierson and Rainey (2017) that detailed bat acoustic surveys from 2001 through 2006 in Sequoia and Kings Canyon National Park. Our ongoing work in 2019 includes four recorders spread throughout Sequoia and Kings Canyon National Park. We paired our 2019 data with data from 2001-2006 at matching locations that were within 10 km, 250 m elevation, and similar habitat type to assess temporal changes from 2001-2006 to 2019. Overall, we find that the number of echolocations calls and species diversity does not differ between paired sites at our four locations. However, we find a consistent pattern whereby bats that echolocate at lower frequencies are present in data from the early 2000s but are absent in 2019, and bats that echolocate at higher frequencies are absent from data from the early 2000s but present in 2019. These results are consistent with predictions based on fire exclusion, which results in more cluttered forest habitats and less open woodlands, providing unfavorable conditions for open-habitat adapted low-frequency echolocating bats and more favorable conditions for clutter-adapted high-frequency echolocating bats.

COMPARING EFFECTS OF PAYMENTS FOR ECOSYSTEM SERVICES PROGRAMS ON SPECIES RICHNESS OVER TIME AND SPACE

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Payment for ecosystem (PES) programs have been widely implemented to help reach conservation goals, especially in rural or developing regions. Generally, PES programs pay landowners to change land uses to maintain and improve ecosystem services. Impacts of such changes in land use have not been significantly
studied in context of wildlife's reaction to land changes derived from PES programs are still lacking. This thesis looks to a nature reserve in China to determine if an active PES program has significant effect on wildlife species richness over time and space. Building off a previous study, data collected from camera traps throughout the Fanjingshan National Nature Reserve (FNNR) in Guizhou, China were used to inform a multi-species hierarchical occupancy model to provide estimates of species-specific and group-specific detection probabilities, probabilities of occupancy, and species richness at each survey site. Specifically, this study looks at two time periods to assess changes in occupancy model results over time through utilizing a cluster bootstrap approach and hypothesis testing. This paper seeks to determine if changes survey site covariates, i.e. human disturbance, and constants in survey site covariates, i.e. PES involvement, have impacted species occupancy and richness within the reserve over time.

*Poster Session*  
*Student Paper*