

2016 Annual Meeting of the Western Section of The Wildlife Society Concurrent and Poster Session Abstracts

(Sorted by Session and Presentation Order)

Challenges and Conflict in Vertebrate Predator Management

A MODEL TO EVALUATE BARRED OWL (*STRIX VARIA*) REMOVAL STRATEGIES FOR NORTHERN SPOTTED OWL (*STRIX OCCIDENTALIS CAURINA*) CONSERVATION.

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In ecosystems throughout the world, lethal removal of one species is sometimes seen as necessary for the conservation of another. Modeling alternative removal strategies can inform decision-making so that resources are not directed towards ineffective or inefficient actions and, perhaps more importantly, to avoid culling animals using strategies with little to no conservation benefit for the species of concern. Lethal removal of barred owls has been proposed as a management option for the conservation of northern spotted owls. We developed an individual-based spatially explicit population model to compare the efficacy and efficiency of alternative barred owl removal strategies. The model evaluates how well an area can be maintained free of barred owls as well as the impact a strategy might have on the broader population of barred owls beyond the removal area. We compared several basic approaches for implementation of removal across space and time within a homogenous habitat. We also identified parameters of interest where further empirical field research could refine model predictions. The flexible nature of the model allows further development to answer more complex questions concerning barred owl removal as well as application to property-specific evaluation when landowners or managers propose or consider barred owl removals.

Challenges and Conflict in Vertebrate Predator Management

Student Paper

HOW TO TRAIN YOUR RAVEN: TESTING THE RESPONSE TO SNOWY PLOVER NEST EXCLOSURES

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Increasing reproductive success is a common management goal for conservation of at risk species. For ground-nesting shorebirds, such as the threatened Snowy Plover (*Charadrius nivosus*), the use of nest exclosures has proven to be a successful strategy to increase nest success. While exclosures may boost hatching success, it is suspected that intelligent predators (e.g., Common Raven, *Corvus corax*) may learn that protected eggs soon hatch to produce nidifugous chicks, which are easily depredated upon leaving the exclosure. We asked if ravens can be habituated to exclosures such that plover productivity increases without compromising adults or newly hatched chicks. Using tracks as an indicator of activity, we assessed whether ravens displayed signs of habituation to exclosures with prolonged exposure. We saturated an area of beach with historically high corvid activity with artificial plover nests protected by "mini-exclosures," which we sampled at 2-day intervals for 5 consecutive months. Here, I will present our results and discuss management challenges, implications, and proposed options for the future.

Challenges and Conflict in Vertebrate Predator Management

Student Paper

INVASIVE SPECIES REMOVAL INCREASES THREATENED CALIFORNIA RED-LEGGED FROG ABUNDANCE AND ALTERS THE DIET OF ENDANGERED SAN FRANCISCO GARTERSNAKES

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Non-native invasive species often have detrimental effects on native ecosystems and species. Eradicating introduced species, however, can disrupt established ecosystem processes. We examined the effects of eradicating introduced fish and American bullfrogs on threatened California red-legged frogs (*Rana draytonii*) and one of their important predators, endangered San Francisco Gartersnakes (*Thamnophis sirtalis tetrataenia*). We monitored an *R. draytonii* population

between 2014 and 2015 during and after the invasive species were removed, and assessed if potential increase in *R. draytonii* abundance also increased their availability as prey for *T. s. tetrataenia*. We observed 0.18 (95% highest posterior density interval, 0-0.89) adult *R. draytonii* per survey in 2014, but 6.98 (4.82-8.82) per survey in 2015. Although no recruitment occurred in 2014, we estimated the peak mean density of *R. draytonii* metamorphs to be 1.98 (1.86-2.12) individuals/m² in 2015. Twenty two percent of *T. s. tetrataenia* samples in 2015 had consumed *R. draytonii*, but none had in 2014. Reference ponds without exotics decreased in *R. draytonii* abundance over a similar period. Removal of bullfrogs and invasive fish directly facilitates the restoration of *R. draytonii* populations and may increase their availability as prey for the endangered *T. s. tetrataenia*.

Challenges and Conflict in Vertebrate Predator Management

IS TARGET MIST-NETTING AN EFFECTIVE CONTROL METHOD FOR REDUCING BROWN-HEADED COWBIRD PARASITISM?

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Brown-headed Cowbird nest parasitism is recognized as a problem for many endangered and sensitive bird species. As a result, managers use cowbird control programs to reduce parasitism. Cowbird traps are the primary method for reducing cowbird populations; investigators may also remove cowbird eggs in host nests and occasionally supplement traps with shooting. Unfortunately, cowbird trapping can be expensive, is limited to areas with vehicle access, and can result in the death or nest failure of many non-target birds. Removing cowbird eggs and shooting also have their drawbacks. Thus, we investigated whether target-netting for cowbird females is effective for controlling cowbirds near areas where the target host is nesting. In 2015, we target-netted female cowbirds in California and compared those results with trapping. The target-netting involved using mist nets, a female cowbird decoy, and cowbird calls. We captured 38 female cowbirds with target-netting, and nine female cowbirds with traps. The capture rate for netting was 0.46 females/hour and 0.04 females/hour for trapping. The number of non-target captures per female cowbird captured was much lower with netting (2.07) compared to trapping (9.22). Our results indicate that netting for female cowbirds is highly effective to remove cowbirds from areas with less impact to non-target species.

Challenges and Conflict in Vertebrate Predator Management

THE CHALLENGE OF NAVIGATING CALIFORNIA GRAY WOLF CONFLICTS (REAL AND PERCEIVED)

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Similar concerns have followed gray wolf (*Canis lupus*) state-by-state expansion in the west both prior to and after reintroduction efforts in the Rocky Mountains in the mid-1990s. Some of these concerns revolve around public perception of the natural world and the influences (both real and perceived) that gray wolves may bring. Combining these concerns with legal mechanisms that provide protections to the species, the consequences of potential and realized wolf-caused damages, along with the evolving presence of wolves in California, results in complex conservation challenges for this species in the state.

Challenges and Conflict in Vertebrate Predator Management

Channel Islands Ecology

ISLAND FOX MONITORING AND DEMOGRAPHY ON SAN CLEMENTE ISLAND

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The island fox (*Urocyon littoralis*) is endemic to the California Channel Islands and the San Clemente Island subspecies is the focus of a long-term conservation program funded and overseen by the U.S. Navy. This program currently includes annual monitoring of fox demography, survival, and disease prevalence. Demographic data are gathered from 12 18-trap grids stratified by habitat type throughout the island. We maintain a radio-collared population of up to 100 individuals to serve as disease sentinels and to gather known-fate survival data. Data suggest a growing population, which reached its highest recorded level in 2014 with an estimate of 1,230 adults. Known-fate survival analysis suggested a high adult survival rate of 95%. Despite several years of drought conditions, the SCI fox population appears healthy, and has grown steadily (186%) over the past 8 years.

Channel Islands Ecology

REPRODUCTIVE SUCCESS OF THE SAN CLEMENTE BELL'S SPARROW ON A RECOVERING LANDSCAPE

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The San Clemente Bell's sparrow (*Artemisiospiza belli clementeae*) is a federally threatened subspecies endemic to San Clemente Island, California. This subspecies was previously considered dependent on boxthorn (*Lycium californicum*) habitat for nesting. However, recent reestablishment of native shrubs other than boxthorn on San Clemente Island has been accompanied by an expansion of the breeding range of the San Clemente Bell's sparrow into areas not historically considered suitable. To explore sparrow breeding ecology in these new habitats, we modeled daily survival rate (DSR) for 200 nests found from 2013-2015, comparing boxthorn habitat to other habitats at 3 spatial scales. Estimated DSR ranged from 0.960 (SE 0.007) in 2014 to 0.979 in 2013 (SE=0.005), with more variation due to year and date of nest initiation than by habitat type. The breeding success of Bell's sparrows in non-traditional areas where shrub species other than boxthorn have recovered suggests the previously described reliance on boxthorn may have been based more on availability than preference. Our findings illustrate how endangered species populations may respond in unexpected way to recovering landscapes, and emphasize the importance of adapting conservation and monitoring efforts accordingly.

Channel Islands Ecology

PEREGRINE FALCON RECOVERY ON THE CHANNEL ISLANDS

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It is estimated that there were 15-30 pairs of breeding American peregrine falcons (*Falco peregrinus anatum*) on the California Channel Islands in the early- to mid-1900s, but they were extirpated by the early 1960s, likely as a result of DDE (a metabolite of DDT) contamination of the Southern California Bight. Small-scale reintroductions occurred on several islands between 1983 and 1998, but there were few comprehensive surveys conducted after the mid-1990s. We conducted annual surveys for peregrines on all 8 California Channel Islands in 2013-2015 to determine population size, nesting success and productivity. We located 45-48 occupied territories each year and the estimated population size now exceeds that of the pre-DDT era. Nesting success averaged 68%, with mean productivity of 1.5 chicks per occupied territory. Although the levels of productivity appear sufficient to maintain the population, factors such as juvenile/adult survival and emigration/immigration rates play an important role in population persistence. Continued

population monitoring and banding of young could provide an improved understanding of these population parameters for the Channel Island peregrines and help determine whether contaminants or other issues are negatively impacting the population.

Channel Islands Ecology

ARGENTINE ANT (*LINEPITHEMA HUMILE*, MAYR) DETECTION, MONITORING, AND ERADICATION EFFORT ON NAVAL AUXILIARY LANDING FIELD SAN CLEMENTE ISLAND

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The Argentine ant, *Linepithema humile* (Mayr), is an extremely invasive ant species that has spread to urban, commercial and natural areas worldwide. This expansion has had detrimental ecological and economic effects, resulting in the allocation of vast amounts of resources to its control in urban and agricultural areas. Efforts are underway to control Argentine ants in ecologically sensitive habitats, such as San Clemente Island, CA. We tested the treatment efficacy of liquid bait in ecologically sensitive habitats using polyacrylamide beads as a delivery matrix. In 2014, five sites (176.95 ha) were treated with this toxicant bait seven times in five months resulting in an initial 99.86% reduction in Argentine ant activity across the five sites. In summer 2015, we conducted low-density intensive monitoring over a 17-hectare area using bait traps in a 3m by 3m grid design. We found recolonization of native ants at and remnant colonies of Argentine ants one year after pesticide application. The polyacrylamide bead delivery matrix was successful in reducing Argentine ant numbers, as shown by this study. Persistent treatment and monitoring will be necessary to ensure complete eradication of Argentine ants from San Clemente Island.

Channel Islands Ecology

Conservation and Challenges in the Urban-Wildlife Interface

DO ELECTROMATS EFFECTIVELY PREVENT LARGE AND MEDIUM-SIZED MAMMALS FROM ENTERING THE HIGHWAY?

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Concerns about highway impacts upon large and medium-sized mammals have led to the development of several new technologies to prevent these animals from entering the highway corridor. We assessed the performance of electrified mats, or "electromats", a new alternative to traditional metal-rail cattle guards to prevent wildlife from entering the highway from ungated access roads. We used automatic camera stations to monitor wildlife responses at 4 electromat sites within a 2.5 mile wildlife exclusion fence project near San Luis Obispo, California. Continual monitoring from July 2012 through July 2014 (totaling 2,149 survey nights) documented 482 visitation events by large and medium-sized mammals, with Mule Deer and Gray Fox accounting for the most detections. On some occasions, animals attempting to cross the electromats were shocked and later showed hesitation to cross again or avoided the mat altogether, but on other occasions animals crossed the electromat without evident shock. Animals that learned to successfully cross the electromats tended to return repeatedly, greatly inflating the proportion of detection events that resulted in successful crossings. Based on our monitoring data, we have developed several recommendations to the design and deployment of electromats that will likely make this technology more effective.

Conservation and Challenges in the Urban-Wildlife Interface

DO LARGE AND MEDIUM-SIZED MAMMALS USE JUMP-OUT RAMPS TO ESCAPE FROM A FENCED HIGHWAY CORRIDOR?

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Exclusion fencing can reduce the number of large and medium-sized mammals within a highway corridor, but can also prevent animals from escaping from the corridor if they enter in other ways, such as at ungated access roads. Earthen escape ramps leading from the highway to the top of the exclusion fence have been proposed as a possible solution by allowing animals to "jump out" of the highway corridor. We assessed wildlife response at 4 jump-out ramps installed as part of a 2.5 mile wildlife exclusion fence project near San Luis Obispo, California. We deployed one automatic camera per site and monitored continually from July 2012 through July 2014 (totaling 2,864 survey nights). We documented 431 visitation events by large and medium-sized mammals, with Mule Deer and Gray Fox being the most frequently-detected species. Mule Deer jumped off of the ramps on several occasions, but these events were comparatively rare. Deer that did not jump out still tended to return to the ramps repeatedly. Gray Fox had a higher proportion of events resulting in jumping off the ramp. We documented several instances of other species jumping off the ramps. Mule Deer, Black Bear or Cougar never used the jump-outs to enter the highway corridor. Our results suggest that jump-out ramps have the potential to reduce the abundance of large and medium-sized mammals within a fenced highway corridor.

Conservation and Challenges in the Urban-Wildlife Interface

ADDRESSING OBSTACLES TO RE-ESTABLISHING THE NATURAL ECOSYSTEM AND NATIVE SPECIES AT MOUNTAIN LAKE IN THE PRESIDIO OF SAN FRANCISCO

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The Presidio of San Francisco is a national park site on the south side of the Golden Gate Bridge. Mountain Lake is a natural lake in its boundaries. The lake's fauna had been replaced with non-native species, and the lake ecosystem greatly disturbed through filling and pollution. Re-establish the natural ecosystem required support for controversial methods including using rotenone to remove non-native species and dredging the lake to remove toxic pollutants. Now, it requires support of the community for changes in behavior such as not releasing non-natives (pets) back into the lake. The variety of approaches used to get support from the local community, politicians, regulatory agencies, advocacy groups and the media will be discussed as well as overcoming constraints for re-establishing Anadota mussels, three-spine stickleback, western pond turtle, and chorus frogs.

Conservation and Challenges in the Urban-Wildlife Interface

URBAN COYOTES OF SOUTHERN CALIFORNIA

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As urban development continues to push into native habitat, coyote-human conflicts are increasing in Southern California. Coyotes (*Canis latrans*) continue to adapt to urban and sub-urban environments, and their populations are growing. This talk will focus on recent studies of urban coyotes. We will emphasize innovative solutions to coyote-human conflicts such as pet predation and attacks on humans. Our discussion will include a summary of recent coyote attacks and an update on a National Park Service study of radio-collared coyotes in downtown Los Angeles.

Conservation and Challenges in the Urban-Wildlife Interface

HUMAN-COYOTE CONFLICT MANAGEMENT IN AN URBAN NATIONAL PARK

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The establishment of Coyotes (*Canis latrans*) in urban areas across the United States is a relatively recent phenomenon that is typically associated with controversy and due to a variety of ecological and societal factors the species will remain ever-present. In the early 2000s the Presidio of San Francisco, an urban national park, had a re-establishment of coyotes. The associated conflicts (whether perceived or real), as well as the management approaches, have been one the most significant contentions among the local community. In order to reduce human-coyote conflict a variety of strategies have been developed and implemented throughout the years. Educational outreach to the community, including informational pamphlets and signage, has been the most applied approach as human behavior is one of the main factors driving a majority of these conflicts. Additionally, a coyote incident response protocol has been developed to standardize the documentation of reported encounters while identifying thresholds and guiding appropriate and consistent responses. More active methods, such as the use of spatial deterrents and/or physical barriers, have been used under specific circumstances. Although these techniques have achieved desired results much improvement remains and are in need of refinement and innovation.

Conservation and Challenges in the Urban-Wildlife Interface

Designing and Implementing Climate Adaptation Strategies

CLIMATE ADAPTATION IN ACTION: CASE STUDIES IN THE SOUTH COAST ECO-REGION

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Are you interested in how climate change might impact your work? Interested in integrating climate change into your planning and management activities? Curious to know how others are integrating climate change science into planning and projects? Five speakers from across the south coast eco-region will present cutting edge efforts to collaboratively support integration of climate change considerations into natural resource management through partnerships, research, planning and action. Partnership: Amber Pairis, Climate Science Alliance-South Coast: Planting the Seeds for Innovative Partnerships: The South Coast Eco-region is alive with projects, planning efforts and partnerships that are focused on conserving the biological diversity and uniqueness of our region, as well as the communities where we live and work. These existing efforts and partnerships are critical to forming the foundation for understanding and building resilience to climate change impacts now and in the future. The Climate Science Alliance-South Coast is a partnership formed to create and support a network of leaders, scientists, and natural resource managers focused on sharing ecosystem-based resiliency approaches to safeguard our communities and natural resources from climate change risks.

Designing and Implementing Climate Adaptation Strategies

PLANNING FOR WILDLIFE MOVEMENT IN A CHANGING CLIMATE

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In southern California, ecological networks established under California's Natural Communities Conservation Planning (NCCP) program have been developed in response to the widespread habitat fragmentation in the region. Over longer time scales, and in the face of changing environmental conditions, connectivity will also prove critical for facilitating range shifts in response to landscape changes caused by development, changing climate, and altered disturbance regimes. In association with California's Department of Transportation (CalTrans), a recent study looked at wildlife movement along Highway 67 in San Diego's backcountry. State Route 67 is the main thoroughfare in and out of the community of Ramona, and safe crossings for wildlife are a major concern as the conserved lands and native habitats adjacent to the road mean that a lot of wildlife lives in close proximity. Collecting information about the existing culvert structures, investigating roadkill, and using previously collected data on bobcat movement will help inform planning efforts on their currently proposed median barrier project and eventually on the planning for the widening of the highway in the future. This information coupled with considerations of climate change impacts on key variables that support connectivity viability will support establishment of feasible and adaptive approaches to retain landscape connectivity and resiliency and will support biodiversity within NCCP networks and across the region. The decision support guide developed in cooperation with partner agencies will identify tangible and feasible actions to improve connectivity and enhance climate resiliency in San Diego's and the region's conservation network.

Designing and Implementing Climate Adaptation Strategies

TECOLOTE CANYON NATURAL PARK NATURAL RESOURCE MANAGEMENT PLAN

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Over 50,000 acres of conserved open space are owned and managed by the City of San Diego. City staff are responsible for conducting monitoring and management actions that are critical to maintaining and improving the biological value of the land. In 2014, the City of San Diego initiated a pilot program to incorporate climate change adaptation measures into its existing natural resource management planning program. A modified approach streamlined the process outlined in the National Wildlife Federation's Climate-Smart Conservation: Putting Adaptation Principles into

Practice (2014) to combine institutional knowledge of the land managers with the best available climate science for the southern California region. The first plan including adaptation planning using the principles of climate smart conservation was for Tecolote Canyon Natural Park, a 950-acre coastal urban preserve in the City of San Diego. By incorporating climate adaptation planning into our existing land management planning process, the City created an efficient mechanism for translating climate adaptation science into actions that are ready for rapid implementation through existing organizational and funding structures.

Designing and Implementing Climate Adaptation Strategies

CLIMATE UNDERSTANDING AND RESILIENCE IN THE RIVER VALLEY (CURRV)

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The CURRV project goal is to build upon a regional commitment of climate change adaptation within the context of other environmental and socioeconomic stressors. The Tijuana River National Estuarine Research Reserve (TRNERR) is collaborating with a diverse group of stakeholders to conduct a vulnerability assessment that informs the development of climate adaptation strategies, specifically addressing sea level rise and riverine flooding. These strategies will provide information to coastal decision-makers managing our natural resources and will build infrastructure tools for effective ecosystem-based management.

Designing and Implementing Climate Adaptation Strategies

THIN-LAYER SALT MARSH SEDIMENT AUGMENTATION PILOT PROJECT

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The US Fish and Wildlife Service (USFWS) will apply a thin-layer of sediment over 10 acres of existing low salt marsh habitat on the Seal Beach NWR, with the hope of documenting the effectiveness of this strategy in combating sea level rise, while also improving quality of cordgrass-dominated salt marsh habitat to support the federally endangered light-footed Ridgway's rail (formerly known as the light-footed clapper rail). The Service will monitor the physical and ecological responses of the marsh for a period of five years, and results will be shared with Federal, State, and local agencies, land managers, and others to assist in developing sea level rise adaptation strategies.

Designing and Implementing Climate Adaptation Strategies

Ecology and Conservation of Amphibians and Reptiles

GIANT GARTERSNAKES (*THAMNOPHIS GIGAS*) SELECTIVELY FORAGE ON NATIVE ANURANS

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The introduction of exotic species can alter trophic dynamics of native species. Threatened giant gartersnakes (*Thamnophis gigas*) forage on a prey community that is comprised almost entirely of exotic species. We examined prey selection of giant gartersnakes by analyzing trap by-catch and regurgitated gut contents of snakes in four basins in the Sacramento Valley of California to determine whether these snakes actively select their prey or if they are simply consuming what is abundant. Although non-native anuran and fish species dominate the available prey community, giant gartersnakes most strongly selected native Sierran treefrogs (*Pseudacris sierra*) metamorphs. If all prey types were equally available, giant gartersnakes would have selected Sierran treefrogs with a probability of 0.596 [0.0254 - 0.855]. Giant gartersnakes also were more likely to select introduced American bullfrog (*Lithobates catesbeianus*) adults over all tested introduced fishes. Managing prey communities to increase native amphibian abundance within the giant gartersnake's range might benefit populations of this rare snake.

Ecology and Conservation of Amphibians and Reptiles

Student Paper

PILOT STUDY FOR USE OF SCENT-DETECTION DOGS IN SURVEYS FOR THE GIANT GARTER SNAKE (*THAMNOPHIS GIGAS*)

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The giant garter snake (GGS) (*Thamnophis gigas*) is federally and State listed as a threatened species endemic to California's Central Valley. GGS require wetlands for foraging, upland areas for basking, upland refugia as summer shelter, and higher-elevation refugia for winter brumation. Visually, the GGS is elusive: these snakes frequently occur in low-density populations in which individuals are difficult to detect. Detection challenges have resulted in a poor understanding of occupancy patterns throughout much of the species' range, particularly in upland habitat. H. T. Harvey & Associates tested the efficacy of using scent-detection dogs to recognize and alert to GGS residual scent and distinguish it from the scent of sympatric garter snake species. We determined the probability of GGS scent detection and calculated a detection error rate for three dog-handler teams, and determined the change in probability of GGS residual scent detection as scent degraded over a period of six months. The use of scent-detection dogs may offer an efficient and innovative survey approach enabling the detection of GGS both above-ground and in upland refugia.

Ecology and Conservation of Amphibians and Reptiles

HABITAT USE AND NEST SITE SELECTION BY THE WESTERN POND TURTLE (*ACTINEMYS MARMORATA*) IN MANAGED CENTRAL CALIFORNIA RANGELANDS

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The western pond turtle (*Actinemys marmorata*) has been declining throughout its range due to a number of stressors including: habitat degradation and loss, exotic competitors, non-native predators, and epidemic disease. Our only native California turtle is listed as a California Species of Special Concern and a candidate species for listing under the federal Endangered Species Act. Few studies have examined the ecology of populations in lentic environments subject to livestock grazing. From 2011 through 2015, staff and volunteers tracked visually and/or using radio-telemetry devices, the seasonal movement patterns, habitat use and nest site selection of western pond turtles in eastern Contra Costa

County, California. Preliminary statistical analyses of this multiple-year database are showing that male and female western pond turtles use the pond environment differently; however, they overwinter in the same relative location. Gravid females on average move 24.4 m. (± 17.5 m.) away from the ponds, nest on south-facing slopes (mean aspect of 134 ± 31.9 degrees) with mean residual dry matter (RDM) levels of 1345 (lbs./acre)(1510 kg/ha), and vegetation heights ranging between 26.6 and 39.5 cm. These research findings show how western pond turtles utilize their pond and upland environment have significant conservation and management implications for rangelands.

Ecology and Conservation of Amphibians and Reptiles

POPULATION STRUCTURE OF PACIFIC POND TURTLE (*ACTINEMYS MARMORATA*) AT A POND IN THE CALIFORNIA DELTA: RESULTS FROM A COMPLETE TRAPPING AND RELOCATION EFFORT

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A complete Pacific pond turtle (*Actinemys marmorata*) trapping and relocation effort occurred as part of a California Department of Water Resources and Ducks Unlimited wetland restoration and levee stabilization project. Trapping and salvage occurred at a 6-acre scour pond on Sherman Island, located in the western California Delta. In April 2015, a trapping effort was conducted prior to initiation of restoration activities. This work was followed with a salvage effort conducted concurrently with construction at the pond which began in late summer and was completed in October 2015. A total of 222 unique individuals encompassing all ages including hatchlings were successfully captured and relocated during the trapping and salvage efforts. Turtles were relocated 0.8 mile away, and only two individuals were recaptured following relocation. Demographic data including sex, carapace size, and coloration were taken on all individuals, and additional data on mass, gravidness, plastron, and inguinal scute size were also gathered during the spring effort. Summary data of turtles captured are presented including size distribution, sex ratio, potential trap biases, and trapping lessons including observations of pond characteristics and species. This study represents the first known trapping and relocation of an entire population of Pacific pond turtle.

Ecology and Conservation of Amphibians and Reptiles

POPULATION RESPONSE OF CALIFORNIA RED-LEGGED FROG TO PREDATOR ERADICATION: A LONG-TERM CASE STUDY

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Agricultural stock ponds have become strong-hold habitats for the federally threatened California Red-legged Frog (*Rana draytonii*: CRLF) in coastal and central California ranch-lands. Where habitat conditions are favorable, CRLF are able to thrive in such environs. Though commonly, non-native aquatic predators dominate at the agricultural urban interface. In 2009, as a component of long-term monitoring and management commitments following the construction of the Pleasanton Municipal Golf Course; WRA identified two individual CRLF persisting at an invasive-dominated pond located on an off-site conservation easement preserved as a component of project mitigation. As a result, WRA embarked on a year-long effort to directly remove non-natives with only marginal results. Ultimately, WRA determined that the best approach would be to dewater the pond, which occurred in 2010. In 2011, the CRLF population began to flourish, increasing in both number and distribution. While the mechanism for such rapid growth is not entirely clear, it potentially suggests CRLF could have more complex associations with upland aestivation habitat.

Ecology and Conservation of Amphibians and Reptiles

Ecology and Conservation of Birds

CUCKOOS ATTRACTING MATES: WHO COOS FOR WHO?

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Female birds have been increasingly found to sing, and those who sing to attract mates appear to do so along with their male counterparts, not as the solo singers. Female-driven systems may exist, but the cryptic nature of many species hinders a better understanding of their mating systems. The coo is a mate attraction signal by yellow-billed cuckoos (*Coccyzus americanus*) that was previously assumed to be given by unmated males, though there is evidence that females also coo. We witnessed cooing in a color-banded population of yellow-billed cuckoos that we DNA-sexed from blood samples. Of 105 males and 80 females, 25 were confirmed cooing, all of them female. Despite the small sample size, our results are compelling that female and not male yellow-billed cuckoos coo, revealing a sex-reversed mating system in which unmated females sing to find available males. This result also complements our discovery of high rates of conspecific nest parasitism among yellow-billed cuckoos in which the nesting male is also the father of the parasitic young. Female cuckoos apparently not only coo to attract unmated males to nest with, but also to locate, mate with, and lay eggs in the nests of already-nesting males.

Ecology and Conservation of Birds

HISTORY AND IMPLEMENTATION OF THE YELLOW-BILLED CUCKOO SURVEY PROTOCOL

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Recently, the Western U.S. Distinct Population Segment of the Yellow-billed Cuckoo was designated as a threatened species under the federal endangered species act. The species has been listed as endangered in California since 1988. Surveys for the Yellow-billed Cuckoos have been conducted since the late 1970s in California, but the current survey protocol has only been in use since the late 1990s. We will discuss the history of the survey protocol and the supporting research that went into developing the survey methods. We will also discuss the management implications of the recent federal status designation, proposed critical habitat, and permitting requirements for researchers, conservation planners, and land managers.

Ecology and Conservation of Birds

NOVEL ACOUSTIC ENVIRONMENTS COMPROMISE SONG PERFORMANCE IN CHIPPING SPARROWS

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Anthropogenic noise has been shown to have substantial effects on avifauna structures and avian vocalization behaviors. Additionally, the performance tradeoff for many songbirds between song length and bandwidth has been extensively documented in the presence of anthropogenic noise. Here we quantified the effects of novel acoustic environments on song performance through quantile regression analyses and quantifying a performance frontier. Chipping sparrow songs were recorded in RCHMA of northern New Mexico in spring of 2009 in areas of anthropogenic noise of natural-gas-well compressors, and in acoustically unaffected areas. Additional data from Xeno-Canto and Podos et al. (1997) was included to provide a more robust and diverse data set for the quantile regression analyses. The quantile regression analysis provided a fitness frontier based on syllables in songs and bandwidth of the song. The best performers were found along the frontier, while the worst performers were found well below the frontier. We analyzed distances of individuals from the frontier, only for the birds we had recorded in RCHMA, and found that individuals found near gas-well compressors were significantly further below the performance frontier. This indicates

that beyond avifauna structuring and shifting singing behaviors, anthropogenic noise has a significant effect on song performance.

Ecology and Conservation of Birds

Student Paper

EFFECTS OF ANTHROPOGENIC NOISE EXPOSURE ON THE FITNESS OF NESTING SONGBIRDS

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Anthropogenic noise is an increasingly prevalent global disturbance. Animals that rely on the acoustical environment, such as songbirds, are especially vulnerable to these sounds. Traffic noise, in particular, overlaps with the frequency range of songbirds, inducing masking effects. Because of this, I expected anthropogenic noise exposure to interrupt parent-offspring communication and lead to potential changes in vigilance behaviors. I investigated the effects of chronic traffic noise on the breeding success of nesting western bluebirds (*Sialia mexicana*) and ash-throated flycatchers (*Myiarchus cinerascens*). I was able to eliminate any self-sorting among individuals and other possible effects of traffic, such as collisions and pollution, by experimentally introducing playback systems into nest boxes after clutch initiation. Preliminary results indicate no effect of traffic noise on *S. mexicana* clutch size, brood weight, or fledgling success. However, preliminary results suggest that *M. cinerascens* may experience fitness consequences from chronic anthropogenic noise exposure. I contrast responses by these two species in light of recent observational work on both species in New Mexico and other studies that have examined fitness consequences of noise.

Ecology and Conservation of Birds

PARENTAL CARE BEHAVIORS IN BRANDT'S CORMORANT (*PHALACROCORAX PENICILLATUS*): EFFECTS ON REPRODUCTIVE SUCCESS AND USE AS INDICATORS OF THE MARINE ENVIRONMENT

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Seabird parental care is thought to influence reproductive success, and the associated behaviors of parental care are linked to the ability to forage in an unpredictable marine environment. Therefore, parental care behaviors and reproductive success in seabirds might be useful indicators of changes in the marine environment. At Castle Rock National Wildlife Refuge we quantified parental care behaviors of Brandt's Cormorants, including nest-attendance and chick provisioning, to test whether parental care predicts reproductive success. Additionally, we examined interannual variation of reproductive success. We used a logistic exposure model to estimate daily survival rates (DSR). Given cormorants' life history traits and parental effort, the proportion of chicks that successfully fledge could be more informative than defining nest success as at least one chick fledging. Therefore, we estimated DSR for each chick, as opposed to each nest. Parental care behaviors and their relationship to chick survival may provide a stronger causal link between seabirds' reproductive success and the marine environment, allowing for better informed management and facilitate more accurate monitoring tools.

Ecology and Conservation of Birds

Student Paper

AMPHIPOD DISTRIBUTION IN RELATION TO SNOWY PLOVER (*CHARADRIUS NIVOSUS NIVOSUS*) HABITAT IN COASTAL NORTHERN CALIFORNIA

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Food is an important factor influencing the distribution and abundance of shorebirds. The Western snowy plover (*Charadrius nivosus nivosus*) is a federally threatened shorebird that breeds and winters along the Pacific Coast of the

United States and Mexico. In Northern California, talitrid amphipods are the main prey of snowy plovers. To better understand this relationship between amphipods and snowy plovers, we quantified amphipod abundance and distribution in suitable plover habitat in Humboldt County, CA. In July and August, we conducted systematic-random ground plots within the wrack, left by the previous night's high tide, to quantify amphipod abundance across beach sites. We also categorized invertebrate densities by collecting core samples over the course of a year at three beach sites where plovers breed and winter. Collated ground plots showed significantly different mean amphipod abundances across beach sites. Core samples also suggest variation in amphipod abundance across sites as well as a seasonal variation within each site. Understanding the distribution and abundance of amphipods will help managers determine how prey availability may influence snowy plover distribution.

Ecology and Conservation of Birds

Student Paper

WESTERN SNOWY PLOVER (*CHARADRIUS ALEXANDRINUS NIVOSUS*) NEST SITE SELECTION AND OYSTER SHELL ENHANCEMENT

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The Pacific Coast population of Western Snowy Plovers (*Charadrius alexandrinus nivosus*) is listed as a federally threatened species and as a California Species of Special Concern. The percentage of crushed oyster shells, shell dimensions, number of shells, and total shell surface area for 19 Western Snowy Plover nests that occurred at the Hayward California Least Tern Colony from 2008 to 2015 were measured. Using pairwise t-tests, these measurements were compared to those obtained from 19 randomly chosen non-nest sites. Results indicate that Western Snowy Plovers at this location select nest sites with a greater percentage of crushed oyster shell substrate, more oyster shells, and a greater surface area of shells than random sites.

Ecology and Conservation of Birds

GREAT GRAY OWLS NESTING IN ATYPICAL, LOW-ELEVATION HABITAT IN THE SIERRA NEVADA

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Great Gray Owls (*Strix nebulosa*) in the Sierra Nevada were once believed to nest rather strictly within mid-elevation conifer forests near montane meadows. However, Great Gray Owl nests, mostly in large oak trees and often far from montane meadows, have recently been discovered in commercially managed forests of the lower-montane zone, where oak-dominated woodlands transition to conifer-dominated forests. We describe the reproductive success, apparent occupancy rate, and habitat associated with eight Great Gray Owl nests monitored between 2006-2015 on Sierra Pacific Industries timberlands. Reproductive success was high, with several nesting attempts producing three fledglings, and an average of 1.8 +/- 1.0 chicks fledged during 22 nesting attempts. In the years following the discovery of a territory, apparent occupancy averaged 87.3% +/- 19.9%. Our results suggest that the lower-montane zone may provide high quality nesting habitat for Great Gray Owls. We also used Maxent to identify potential Great Gray Owl nesting habitat throughout the lower-montane zone of the Sierra Nevada, based on conditions around the nests we studied. Our model identified areas within 10 counties of the central and northern Sierra Nevada that we recommend be surveyed for Great Gray Owls.

Ecology and Conservation of Birds

NESTING BIRD POLICY: WE CAN DO MUCH BETTER

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Federal and state laws regulating the wholesale slaughter of nesting birds by early hunters and collectors saved many avian populations. A century later, the same statutes are being applied to various other activities with potential to incidentally disrupt nesting birds. Enforcement is largely limited to governmental agencies, other large land managers, and energy projects. Agriculture and the general public seldom attract regulatory scrutiny. In the vanishingly small percentage of situations that are effectively regulated, the laws protect individual birds and their nests, ignoring the main drivers of avian population declines: loss, degradation, and fragmentation of natural habitats. Thus, as modern conservation tools, these laws are both arbitrary and ineffective. Furthermore, court decisions have recently cast legal doubt on federal plans for a Migratory Bird Treaty Act permitting system to govern the unintentional take of birds by industry. Federal and state governments should abandon the quixotic effort to address bird-conservation threats via archaic hunting laws in favor of modern permitting systems that reasonably limit enforcement to industries with the greatest potential to diminish bird populations, while providing flexibility for approved projects. Applying some of the permit fees toward dedicated habitat restoration programs would help to mitigate avian population declines.

Ecology and Conservation of Birds

OBSERVED AND PREDICTED EFFECTS OF HOUSING DEVELOPMENT ON BIRD SPECIES RICHNESS AND ABUNDANCE IN US PROTECTED AREAS

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Biodiversity conservation is a primary goal of protected areas. However, over the past half-century in the United States, housing growth at the boundaries of protected areas has boomed, and is predicted to continue throughout the 21st century. It is unclear how this development affects the conservation benefit of these protected areas. We used data from the North American Breeding Bird Survey to explore how the abundance and richness of species of greatest conservation need (SGCN) and synanthropes (species affiliated with human settlement), within protected areas, are associated with housing density on nearby private lands from 1940 to 2100. SGCN were generally strongly negatively associated with housing density whereas the opposite pattern was found for synanthropes. The strength of the association varied geographically. In the densely developed eastern forests, as housing development increased from 1940 to 2010, SGCN steadily declined whereas synanthropes steadily increased. In the sparsely populated west, we found similar trends from 1940 to 2010, though the effect size grew stronger from 2010 to 2100. Our results raise concern that as housing development continues at the boundary of protected areas, the conservation benefit of these lands will likely be diminished.

Ecology and Conservation of Birds

Ecology and Conservation of Desert Tortoise

MODELING AGASSIZ'S DESERT TORTOISE POPULATION RESPONSE TO ANTHROPOGENIC STRESSORS

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Agassiz's desert tortoise populations are exposed to a variety of anthropogenic threats that vary in nature, severity, and frequency. Tortoise management in conservation areas can be compromised when the relative importance of these threats is not well understood. We used HexSim to develop simulation models for desert tortoise populations occupying two study areas in the western-central (Superior Cronese) and the eastern (Gold Butte-Pakoon) Mojave Desert, each with a distinct set of site-specific threats. We parameterized threats models from published sources of information, and conducted independent simulations of threats at varying levels of severity. We subjected modeled tortoise populations to simulations of threats associated with human presence and subsidized predators. Additional simulated threats in the Superior Cronese region included disease and habitat degradation on land in-holdings, whereas Gold Butte-Pakoon modeled tortoise populations were exposed to simulations of wildfire, livestock grazing, and feral burros. We used our study area-specific simulation models to rank the threats' relative importance to population viability. We found that threats more widely distributed in time and space significantly limited tortoise population growth more than threats that were patchily distributed or temporally dynamic, allowing us to provide site-specific management recommendations that accounted for the relative effects of the threats.

Ecology and Conservation of Desert Tortoise

INVASIVE PLANT SPECIES ALTER DIETS AND REDUCE FITNESS AND SURVIVAL IN JUVENILE MOJAVE DESERT TORTOISES

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Habitat disturbance in the Mojave Desert alter the native plant composition used for food by Mojave desert tortoises. Food species such as native grasses and native forbs are often intermixed or replaced with non-native grasses such as red brome. We hypothesized that changes in available forage species and the nutrition they provide would negatively influence tortoises. To test this hypothesis, we conducted an experiment with juvenile tortoises to monitor the effects of altered diets on their overall body condition, immunological responses (gene transcription), growth, and survival. Tortoises were fed either a mixture of four native forbs, a native grass (*Vulpia octoflora*), a non-native grass (*B. rubens*), and native forbs combined with either a native or a non-native grass. Tortoises fed forbs had improved body condition and immunological responses, grew more, and had higher survival rates than those consuming other diets. Health and body condition quickly declined for tortoises foraging only on the native grass or non-native grass. Within four months, 32% of individuals fed only *V. octoflora* and 37% fed only *B. rubens* were found dead or removed from the experiment due to poor condition. In contrast, tortoises fed forbs had zero mortality and none were removed from the experiment.

Ecology and Conservation of Desert Tortoise

Student Paper

COMPARISONS OF HEALTH IN AGASSIZ'S DESERT TORTOISES AT THREE SITES IN THE MOJAVE DESERT

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In spring of 2012, we evaluated 126 adult desert tortoises (*Gopherus agassizii*) for health at 3 sites in the Mojave Desert, California (Edwards Air Force Base, western Mojave Desert, N = 51; northwest of Barstow, central Mojave Desert, N = 33; and south of Daggett, southern Mojave Desert, N = 42). We tested for two known pathogens (*Mycoplasma agassizii*, *M. testudineum*), for levels of elemental toxicants in fresh whole blood (selenium, arsenic,

cadmium, lead, mercury, nickel, thallium, antimony, beryllium, chromium, and vanadium) and evaluated the tortoises for clinical signs of upper respiratory disease, shell disease, and trauma. Tortoises with infectious disease, shell disease, trauma, and elevated levels of selenium, arsenic, cadmium, lead, mercury, nickel and thallium occurred at one or more sites. Test results and clinical signs varied by area, possibly as a result of land use histories.

Ecology and Conservation of Desert Tortoise

IDENTIFYING CLIMATE REFUGIA: A TOOL TO INFORM CONSERVATION STRATEGIES FOR AGASSIZ'S DESERT TORTOISE IN A WARMING FUTURE

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Agassiz's desert tortoises, *Gopherus agassizii*, face threats from a wide range of land uses within the California deserts, as well as from a warming and drying regional climate. Mitigation for tortoise multiple-use conflicts could entail habitat protection or translocation to avoid direct take of tortoises. Complicating this mitigation approach is that some areas now deemed suitable tortoise habitat will likely have reduced suitability as climate change effects become more pronounced. If we protect lands or translocate tortoises to currently suitable but potentially deteriorating habitats, are we adequately mitigating for habitat losses? Identifying climate refugia, habitats capable of sustaining tortoise populations even as climate change impacts become more pronounced, is a critical step. As a case study of how to address tortoise mitigation we employed habitat suitability modeling to identify current tortoise habitat and project where climate refugia will occur within and surrounding the U.S. Marine Corps Air Ground Combat Center (MCAGCC) at Twentynine Palms, California. We modeled nearly 284,000 ha of currently suitable tortoise habitat within an 858,800 ha study area. Projecting a possible +3°C shift in mean maximum summer temperatures by the end of the century, the area of tortoise habitat could be reduced 55% to 127,650 ha, however almost 115,800 ha would overlap current tortoise habitat and would be climate refugia. Without the tenuous assumptions of successful dispersal to new suitable habitat, these refugia represent high value conservation areas for current protection and, if required, for sites to translocate tortoises. Applied across the tortoise's range, this approach could focus and increase the efficacy of conservation for this threatened species.

Ecology and Conservation of Desert Tortoise

Ecology and Conservation of Mammals

SPATIAL AND TEMPORAL HETEROGENEITY OF RESOURCES IN ARID LANDS: POPULATION CONSEQUENCES FOR MULE DEER

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In arid environments, resources often limiting and are widely or patchily distributed. Understanding the use of limited resources by large-bodied herbivores presents unusual challenges in arid ecosystems because body size is related to both physiological needs and broad spatial distributions of animals and resources. A key component in arid environments is availability of free-standing water; we examined resource selection and population demographics relative to available resources and nearness to permanently available water. We used mule deer (*Odocoileus hemionus*), a medium-bodied ungulate with wide distributions across North America, to investigate effects of limited and widely distributed resources on demographics, patterns of space use, and selection of resources. We modeled selection of resources seasonally to understand distributions and selection of resources by ungulates relative to their demographics. We also modeled selection of birth sites relative to survival of neonates. We used program MARK to evaluate survival of adults and young. Adult mule deer selected for high elevations and closer to sources of water in all seasons. Adult survival was highest during high precipitation years and lowest during drought years. Neonate survival was highest with individual births occurring early than the median birth date, and larger neonates at birth had higher survival. Adult females selected birth sites with about 40-50% shrub cover and close to sources of water. Understanding how ungulates select and use limiting resources, especially with changing weather patterns and urban development in arid ecosystems, and understanding the correlation of resource selection with population demographics will likely be a key components to maintaining viable populations of large mammals in arid environments.

Ecology and Conservation of Mammals

STATEWIDE ASSESSMENT OF TOWNSEND'S BIG-EARED BAT IN CALIFORNIA: A COLLABORATIVE EFFORT FOR A CANDIDATE SPECIES

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We are assessing Townsend's big-eared bat (*Corynorhinus townsendii*; hereafter COTO) roost sites throughout California. Broad-scale evaluation of COTO has not occurred since Pierson and Rainey's work in the late 1980s. The species is now a candidate for listing under the California Endangered Species Act. Understanding the current status and nature of roost sites will support management of this species, regardless of listing outcome. We are (1) revisiting historic roosts documented in State databases to determine presence; and (2) sampling potential habitat in randomly selected cells drawn from the Pacific Northwest Bat Grid system and NABat. Field work will continue through winter 2016-17. These data will inform a model seeking to explain COTO occupancy. Preliminary results suggest that many officially known sites no longer host bats, yet that a number of sites had never been reported to California Department of Fish and Wildlife by recreational communities, land managers and other agencies. As such, we have expanded our efforts to include these sites and to capitalize on opportunities to raise awareness. Developing this network of non-traditional partners and data sources may represent a relatively untapped resource for research and management applications for bats and other species.

Ecology and Conservation of Mammals

CHANGES IN THE DISTRIBUTION OF THE EASTERN GRAY SQUIRREL, *SCIURUS CAROLINENSIS*, IN CALIFORNIA FROM 1900-2015 WITH PROJECTIONS FOR ITS POTENTIAL FUTURE RANGE

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The main goals of this study were to map the current distribution of the Eastern Gray Squirrel in California as of 2014 and to examine changes in the distribution of the species from approximately 1900 to 2014. Data were obtained from museum specimens, wildlife rehabilitation centers, a roadkill database, and research-grade citizen observations. Location points were mapped using ArcGIS software. A population is located from San Francisco south to areas around Gilroy and Santa Cruz. This population is positioned to expand north along the eastern side of San Francisco Bay. An isolated population now exists in and around Monterey. A population became established north of the Golden Gate Bridge. Another population exists from Marin City to Santa Rosa. A population introduced to Sacramento has spread west, south, and east of the city. The species is present from Davis, to Placerville, and Elk Grove. A population introduced to Bellota has spread to Stockton and the Sierra Nevada Mountain foothills. Ecological niche modeling software and remote sensing data has been used to project future range expansion by this species within California.

Ecology and Conservation of Mammals

Student Paper

SALT MARSH HARVEST MOUSE HABITAT PAST, PRESENT, AND FUTURE: OUR EVOLVING UNDERSTANDING OF THE HABITAT REQUIREMENTS OF THIS "HABITAT SPECIALIST"

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For decades the salt marsh harvest mouse has been managed as a habitat specialist, dependent on pickleweed dominated tidal marshes. However, more recent research and monitoring has revealed a much more adaptable rodent than previously believed. As we face an increasingly uncertain future of climate change, sea level rise and the challenges of tidal restoration, what do we need to keep in mind? In this talk I will discuss the historical state of the salt marsh harvest mouse range, how we currently perceive and manage habitat, and directions we need to consider as we manage this species in the face of future uncertainty.

Ecology and Conservation of Mammals

Student Paper

DIGGING INTO THE IMPORTANCE OF ANTHROPIC LAND USE IN SPECIES DISTRIBUTION MODELS

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Wise land-use planning is particularly important in the urban-wildlife interface where conservation and development efforts come into conflict. Due to limited empirical information about landscape composition and wildlife movement, conservation professionals often rely on species distribution models for strategic planning. Maxent generates distribution models using species occurrence and environmental datasets. Although the built environment can influence the distribution of species, human land use is rarely included in these models. Does including land-use improve the predictive ability of a species distribution model? To address this question we used Maxent to construct and compare models with and without land-use variables for gray foxes, carnivores sensitive to the wildlife-urban interface. We created both models using a combination of gray fox presence-only (n=209) and presence/absence (n=52) records, and 9 environmental and anthropic land-use variables. Including land use resulted in a more accurate model, with land use ranked in the top 3 variables and explaining 60% of the model's importance. Gray fox distribution was correlated with locations in low-density development and closer to roads. Species distribution models that include land use can be used to target priority habitat for conservation, thereby minimizing current conservation conflicts and maximizing resilience to future climate change.

Ecology and Conservation of Mammals

Student Paper

Ecology and Conservation of Mesocarnivores

CHARACTERISTICS OF FISHER (*PEKANIA PENNANTI*) REPRODUCTIVE DENS IN THE SOUTHERN SIERRA NEVADA

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Successful reproduction is critical to maintain populations; for many species, habitat plays a key role in providing suitable locations for females to give birth and care for young. Concern for the long-term persistence of fisher (*Pekania pennanti*) in the Sierra Nevada has involved efforts to protect habitat to support reproduction, but until recently few reproductive dens had been found in this area. From summer 2008 through 2014, we used telemetry to follow 34 adult female fishers with radiocollars to 247 reproductive dens on the Sierra National Forest, California. Females used cavities in live trees and snags to shelter kits and selected California black oaks (*Quercus kelloggii*) as natal (50%) and maternal dens (53%) more than any other tree species. Diameter of den trees was generally large for natal (mean dbh of hardwoods = 77 cm $\bar{x} \pm 22$, conifers = 114 cm $\bar{x} \pm 28$) and maternal dens (mean dbh of hardwoods = 75 cm $\bar{x} \pm 19$, conifers = 106 cm $\bar{x} \pm 25$). Mean canopy cover was relatively dense at natal (74% $\bar{x} \pm 13$) and maternal dens (73% $\bar{x} \pm 14$). We present findings on other characteristics of den structures and habitat selection at several spatial scales, and implications for regional fisher conservation.

Ecology and Conservation of Mesocarnivores

Student Paper

VARIATION IN INTERSPECIFIC NICHE OVERLAP ACROSS A LATITUDINAL AND CLIMATIC GRADIENT: MARTEN AND FISHER AT THEIR RANGE MARGINS IN THE SOUTHERN SIERRA NEVADA

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We explored species' niche relations of marten and fisher at the southern margins of their ranges in the southern Sierra Nevada (SSN) using data from 2 sources: (1) large-scale camera, track-plate, and hair-snare surveys and (2) data on overlap of marten and fisher home ranges from radio-marked individuals. These sources made it possible to examine the current distributions with high resolution and to explore how the spatial pattern of those distributions (parapatric, sympatric, allopatric) change along latitudinal, elevational and climatic gradients. We found significantly different spatial patterns across the SSN: marten and fisher were primarily allopatric in the northern and wetter portions of the study area but sympatric at intermediate latitudes with lower precipitation. In the driest and southernmost region martens were virtually absent but fishers were routinely detected at significantly higher elevations. Within the region of sympatry telemetry data demonstrated significant spatial overlap occurred at the level of the home range with 84% of marten exhibiting spatial avoidance of fisher where the species' home ranges overlapped. Studying how the warmer and drier environment at the southern end of species' ranges affects distributions and interactions may provide insights about future distributions and spatial interactions farther north as the climate warms.

Ecology and Conservation of Mesocarnivores

LANDSCAPE FUEL REDUCTION, FOREST FIRE, AND BIOPHYSICAL LINKAGES TO LOCAL HABITAT USE AND LOCAL EXTINCTION OF FISHERS (*PEKANIA PENNANTI*) IN THE SOUTHERN SIERRA NEVADA

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Fire suppression contributed to major changes in California's Sierra Nevada forests. Landscape fuel treatments are being used to reduce wildfire intensity and spread, but may negatively impact fishers. We used cameras to survey for fishers among 1-km² grid cells in the Sierra National Forest, and applied occupancy modeling to evaluate responses of fishers to disturbance from forest fuel reduction. We detected fishers most often between 1380 m and 1970 m elevation, and detection probability occupancy was higher in habitats with high canopy cover. Local habitat use trended downward among cells with higher levels of managed burning+forest fires 25 years before surveys, and in cells where disturbance from restorative fuel reduction was higher. Local extinction increased with higher levels of restorative fuel reduction, but was not diminished by prior burning, or extractive activities. A trend for lower fisher occupancy in extensively burned grids suggested that wildfires did not decimate suitable fisher habitat. Wildfires increased in our study area after the 1980s, and may impinge on forests with higher fisher occupancy in the future. Forest fuel reduction imposes a more limited short term cost to fishers than previously believed, but less is known about the responses of denning fishers to management disturbance.

Ecology and Conservation of Mesocarnivores

NATURAL AND HUMAN-LINKED MORTALITY RISKS AND LIMITS TO POPULATION GROWTH OF FISHERS IN CALIFORNIA

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Fishers in Washington, Oregon, and California have not recovered from population declines and the U. S. Fish and Wildlife Service has proposed to list them. We evaluated survival and mortality risks among 232 radiocollared fishers in the Sierra National Forest. We estimated mortality rates using non-parametric incidence functions, and integrated risk-specific survival rates into a Leslie matrix to evaluate how population growth (λ) might improve if management can reduce mortality. Cause of death was determined for 93 of 121 fishers, and annual survival was 0.72 for female fishers. Mortality rates were 19.5% for predation, 2.5% for disease+injury+starvation, and 1.9% for toxicant exposure+vehicle strikes. Predation rates were similar between sexes, but predation risk was 51% lower in fall and winter compared to spring and summer. The mortality rate from disease+injuries+starvation+vehicle strikes+toxicants was 4.4%, and 11 times higher for males than females. We estimated a base λ of 0.96, which had the potential to increase to 1.03 or 1.11 if predation were reduced by 25% or 50%. λ could increase to 0.97 in the absence of all other risks besides predation. Predation was the dominant limiting factor, and research is needed on habitat conditions that facilitate contact between fishers and larger predators

Ecology and Conservation of Mesocarnivores

PARENTAL CARE IN URBAN SAN JOAQUIN KIT FOXES (*VULPES MACROTIS MUTICA*): RELATIVE ROLES OF ADULT GROUP MEMBERS IN PUP REARING

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A substantial population of endangered San Joaquin kit foxes exists in the City of Bakersfield and is critical to conservation and recovery. We investigated parental care among these urban kit foxes. We quantified relative time contributions of adults, tasks performed, and changes in behavior over time through focal observation sessions. To determine role, we used behaviors and genetic analyses to classify adults into categories: Mother, Father, or Helper. To monitor behavioral changes over time, we split the breeding season into periods: Preparturition, Nursing, and Weaned.

We monitored four family groups in Bakersfield during the 2011 and 2012 breeding seasons. We found that Mothers spend significantly more time at the den than either Fathers or Helpers. Fathers provision the same amount as Mothers, whereas Helpers provisioned significantly less than either Mothers or Fathers. Mothers primarily groomed young, provisioned, guarded, and performed den defense. Fathers primarily provisioned and provided den defense. Helpers mostly interacted with the pups through play, though on occasion provided care. Helpers do not significantly assist in rearing pups and Fathers are not as necessary to successful pup rearing. Mothers play an essential role in pup rearing and are necessary for successful reproduction in the urban environment.

Ecology and Conservation of Mesocarnivores

Student Paper

Ecology and Management of Wildlife on Military Lands

MONITORING ENDANGERED BLACK ABALONE ON VANDENBERG AND SAN CLEMENTE ISLAND

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Since the mid 1980s, black abalone (*Haliotis cracherodii*) have experienced mass mortalities due to "withering syndrome" and are currently protected under the Endangered Species Act. Multi-Agency Rocky Intertidal Network (MARINE) has monitored abalone populations on the California coast for over 20 years and have documented their decline. Monitoring data show that once a population crashes, community structure changes, possibly contributing to recruitment failure. We have assessed abalone populations and habitat quality on two military lands: Vandenberg Air Force Base (US Air Force) and San Clemente Island (US Navy). Abalone populations on Vandenberg were some of the earliest on the mainland to experience decline. We have monitored sites since 1992 on Vandenberg and monitoring here was crucial to documenting the northward spread of the disease. In 2011-12 we conducted abalone population and habitat surveys on San Clemente Island. These surveys found only a remnant population of black abalone and suggested that the lack of adults may reduce suitable recruitment habitat. We initiated a habitat restoration trial in which cracks were cleared of fouling organisms to conditions consistent with the presence of adults. We are continuing this restoration approach by maintaining crack clearings, installing and testing abalone recruitment modules, and monitoring for recruitment and signs of disease.

Ecology and Management of Wildlife on Military Lands

SPECIES LEVEL IDENTIFICATION: GENETIC APPROACHES ARE CLOSER TO BECOMING ROUTINE

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There are a number of wildlife species in the state of California that are difficult to identify. Kangaroo rats (*Dipodomys spp.*) are a good example, especially at the species and sub-species levels. Genetic analyses could provide an alternative way to survey for, and monitor, species that are difficult to identify, or difficult to capture. Yet, applying genetic analyses to listed taxa can be hindered by the invasive nature of blood and tissue sampling or by the fact that they are rare and difficult to sample directly. Therefore we developed a method of non-invasive indirect (scat and hair) sampling for kangaroo rats that improves on existing DNA protocols. To generalize this method, we developed a database of diagnostic mitochondrial DNA sequences for each listed kangaroo rat taxon in California, and applied this method in a species-level survey. We also used the method to assess survivorship and reproduction in a translocated population of listed kangaroo rats. We show it is possible to use an indirect, non-invasive, approach for the identify of individual kangaroo rats and for species level assignments, and argue that this approach could be extended to other listed taxa.

Ecology and Management of Wildlife on Military Lands

ENDANGERED SPECIES PREDATOR CONTROL STRATEGIES, MCB CAMP PENDLETON

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One of the last undeveloped stretches of coastline in Southern California, Marine Corps Base Camp Pendleton beaches are important nesting grounds for federally endangered California least terns and federally threatened western snowy plovers. Camp Pendleton's 125,000 acres encompass a variety of habitat types such as grassland, oak woodland, coastal sage scrub and riparian, enabling a healthy population of raptors, corvids, and other avian, mammalian, and reptilian predators. Many of these forage on the beaches and pose a significant threat to the recovery of nesting terns and plovers. Predator removal is an effective management tool that has been used on Base for more than 20 years to

protect endangered shorebird populations. Various non-lethal methodologies implemented on Base include hazing, trapping, taste aversion conditioning, and translocation; lethal removal is also employed when necessary. Nests lost to depredation have gradually decreased over the last five years in California least terns (11%) and western snowy plovers (24%) concurrent with drought conditions and change in management strategy. Accurate identification of individual predators for removal and effectiveness of non-lethal methodologies continue to present challenges to predator control. Camp Pendleton continues to seek new and innovative strategies to reduce predation pressure on federally protected species and contribute to ultimate recovery goals.

Ecology and Management of Wildlife on Military Lands

LONG-TERM MOVEMENTS OF TRANSLOCATED RAPTORS, MARINE CORPS BASE CAMP PENDLETON, 2013 - 2015

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Marine Corps Base Camp Pendleton utilizes a variety of techniques to manage predators, including translocation, as part of its efforts to protect federally listed species that nest on Base. This study quantified return rates and survival of raptors fitted with satellite transmitters and translocated at least 240 mi. Over three breeding seasons we translocated 20 raptors of five different species. Northern harriers (*Circus cyaneus*) were the most frequently documented and translocated species. Eleven individuals returned. Most (80%) birds survived 60 days or longer following translocation. There is some evidence to suggest that birds that had achieved breeding age returned more quickly to the Base and survived longer. However, our sample size was small and there were no significant differences in return rates or mortality based on species, age, sex, or breeding status. We recommend an approach for "problem raptors" of different species and breeding status based on these initial results. Additional research is needed to compare return rates of raptors translocated the shorter USFWS recommended distances with the results from this effort and also to research the effects of a short period of captivity, to further reduce homing behavior, coupled with translocation.

Ecology and Management of Wildlife on Military Lands

THE CURRENT STATUS OF GOLDEN EAGLES ON THE NEVADA TEST AND TRAINING RANGE (NTTR)

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Since 2011, Annual Golden Eagle (*Aquila chrysaetos*) surveys have been conducted on the Nevada Test and Training Range (NTTR). NTTR is a closed and access restricted active military test and training range approximately 3.0 million acres in size. NTTR is composed of Mohave desert habitat (South Range) and Great Basin habitat (North Range). The purpose of these surveys were to locate all known and potential nests, nesting activity and annual production of golden eagles. Due to access and equipment restrictions, it was necessary to implement unique survey techniques. Survey techniques, nesting data collected, nest productivity and recommendations will be presented.

Ecology and Management of Wildlife on Military Lands

DESERT TORTOISE HEAD-START RESEARCH AT THREE MILITARY BASES IN CALIFORNIA'S MOJAVE DESERT

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In 1989, D.J. Morafka began implementing his head-starting strategy for conserving desert tortoises at the US Army's Ft. Irwin by building large enclosures over natural habitat that were fenced and netted to exclude tortoise predators.

Similar pens were subsequently built at Edwards Air Force Base and at Twentynine Palms Marine Base. Local wild adult female tortoises were moved inside temporarily in spring in time to prepare their nests in existing or new burrows and to donate their first clutch of eggs before being returned "home". Enclosed nests, eggs, hatchlings, yearlings and juveniles have long-term protection from predators along with natural foods, and young tortoises are given drinking opportunities (mimicking natural rainfall events) until they are large enough for likely survival to adulthood after release to the wild. Specific research projects that have been done by the UCLA group on enclosed young tortoises include measurements of burrow characteristics and preferences, winter activity and behavior, daily and annual food, energy and water requirements, diet, water budgets and dehydration rates under differing burrow conditions, shell hardening rates, multiple paternity frequencies, the influence of supplemental irrigation on juvenile growth, body condition and survivorship, post-release behavior, survivorship and mortality, and variation in head-started hatchling sex ratios.

Ecology and Management of Wildlife on Military Lands

INTO THE GREAT WIDE OPEN: HEALTH AND SURVIVAL OF 119 HEAD-STARTED AGASSIZ'S DESERT TORTOISES AT EDWARDS AIR FORCE BASE, CA

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Edwards Air Force Base initiated an Agassiz's desert tortoise (*Gopherus agassizii*) head start program in 2002. Head-start pens were installed and adult females from surrounding areas were used to deposit eggs from 2003 through 2010. A staggered release of 119 juveniles commenced in 2013, occurred in three seasonal groups and at two release locations: (1) fall 2013 - 35 juveniles released at Leuhman Ridge; (2) spring 2014 - 36 juveniles released at Baker-Nunn; and (3) fall 2014 - 48 additional juveniles released at Leuhman Ridge. As of October 2015, 63 (53%) are known to be alive, 17 (14%) are dead and 39 (33%) are missing. Survival has varied among release groups. The majority of dead animals appear to have been killed by small mammals, with a novel observation of a predation attempt by a glossy snake (*Arizona elegans*). Since release, we observed seasonal shifts in condition indices, with median values approaching a prime index value (0.64) in spring and falling below a level expected for dehydrated tortoises (0.45) in fall. Growth in midline carapace length has been minimal, a possible consequence of recent drought and/or stunting as a result of high densities in the head-start pens.

Ecology and Management of Wildlife on Military Lands

LANDSCAPE GENETICS OF THE SAN DIEGO FAIRY SHRIMP (*BRANCHINECTA SANDIEGONENSIS*)

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The San Diego fairy shrimp (*Branchinecta sandiegonensis*) is listed as federally endangered as a result of large-scale urbanization and subsequent vernal pool habitat loss. When new pools are created for mitigation or disturbed pools are restored, sediment from existing pools may be used for inoculation. The success of these projects can depend on whether source material is taken from a gene pool that is differentially adapted from the destination. Previous studies have suggested that there are at least two relatively differentiated gene pools of San Diego fairy shrimp within San Diego County. A putative contact zone between these gene pools occurs primarily on land owned by the Marine Corps Air Station at Miramar (MCAS Miramar). Using the mitochondrial gene COI in conjunction with seven microsatellite loci, we have delineated the relatively abrupt gene pool boundary with greater precision than was previously known. We have also tested for additional population structure within each of these regional gene pools, based on a variety of pool-specific and landscape features. A greater understanding of the processes underlying genetic population structure in endangered species such as the San Diego fairy shrimp can lead to more effective management and conservation decisions.

Ecology and Management of Wildlife on Military Lands

Student Paper

UNDERSTANDING FERAL CAT ECOLOGY IN AN ISLAND ECOSYSTEM: RESEARCH ALLOWS FOR ADAPTIVE MANAGEMENT MITIGATING IMPACTS ON SENSITIVE ENDEMIC SPECIES

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Because invasive species pose tangible and often immediate threats to native biota, conservation biologists often focus on controlling or eradicating them without first understanding their ecology or functional roles in their adopted ecosystems. On San Clemente Island, California, feral cat (*Felis catus*) control has occurred for >20 years. Our long-term dietary analyses revealed a strong preference for native rodents, transition to reptilian and avian prey when rodents declined, and substantial cumulative impacts on the vertebrate prey base. We used GPS collars to examine home-range, habitat use, and to evaluate population control efficacy. Cementum annuli age estimates and population reconstruction analyses revealed a relatively stable population with some individuals living >15 years. In addition to direct effects through predation, we found cats likely compete for resources in both time and space with endemic island foxes (*Urocyon littoralis*) and endangered San Clemente loggerhead shrikes (*Lanius ludovicianus mearnsi*). Cats are more robust to removal techniques than was previously thought, and individuals may persist for many years despite the seemingly harsh environment and intensive control program. Our findings provide insight into interactions with native species, allow us to evaluate the feasibility and possible cascade effects of eradication, and inform future conservation efforts.

Ecology and Management of Wildlife on Military Lands

SNOWY PLOVER NEST SITE SELECTION AND DISTRIBUTION BEFORE AND AFTER RESTORING COASTAL DUNE HABITAT ON VANDENBERG AIR FORCE BASE, CALIFORNIA

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Eradication of non-native invasive vegetation within breeding habitat for the Western snowy plover (*Charadrius nivosus nivosus*) began on Vandenberg Air Force Base in 2009. After adequate invasive plant treatment had been completed, two sections of coastal dunes were mechanically contoured to create optimal snowy plover breeding habitat; one in early 2014 and the other in early 2015, opening up 30.5 hectares of previously marginal habitat. We assessed the response of nesting plovers by analyzing changes in nest density, hatch success, and nest site selection inside contoured areas and at adjacent control sites from five seasons (2011-2015). Both contoured sites showed increased nest densities during the first year post-contouring, but still had lower densities compared to control sites. Thus, it appears that nesting plovers moved into contoured areas to reduce overall nest densities and increase territory size. In 2014, the first contoured site showed increased hatching success compared to prior years and higher hatching success than control sites where predation rates were high. In 2015, hatching success increased at all sites compared to prior years and was similar between contoured and control sites. Further investigation will be required to determine whether dune contouring will have a lasting impact on hatching success.

Ecology and Management of Wildlife on Military Lands

Human-Wildlife Conflict and Solutions

BIOLOGICAL CONSERVATION - PEOPLE MATTER (A POSITIVE VIEW)

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Can the foundation of biological conservation be human relationships (feelings)? Being able to work with people with different interests, views and values on an individual level, may result in better conservation ideals. As scientists we are taught to think in absolutes; however, the general public usually does not decide on issues through facts. As a society, we decide on issues through relationships and feelings. Sometimes scientist forget that conservation does not mean the absence of humans. As a whole, the scientific community does not focus on the human to human relationships. We believe ensuring good science and giving the facts of our research should be worthy enough for conservation. Gradually, conservationists are recognizing what the current research is proving; good science is only a part of conservation. Communities want and need good science to point them in the right direction and to help ensure that what they want to protect is important. However to understand what is important to a community, we must begin by building positive human to human relationships.

Human-Wildlife Conflict and Solutions

OPPORTUNITY FROM CONFLICT: RESTORING SPECIAL STATUS SPECIES HABITAT ON CALIFORNIA'S NORTH COAST

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In the mid-1960s, Pacific Shores Subdivision was carved from the coastal dunes and wetlands of Del Norte County, California. The site was never fully developed, although 27 miles of roads were built to access 1,500 half-acre lots which sit vacant today except for scattered homeless encampments. Coastal prairie, marshes, wetlands, and spruce forest provide habitat for diverse wildlife including black bear, porcupine, northern harrier, Oregon vesper sparrow, northern red-legged frog, and Oregon silverspot butterfly. Although half the parcels have been acquired by state agencies and local non-profits, frequent conflict and litigation between property rights advocates and conservation organizations prevented restoration. Congressionally mandated runway safety area improvements at Crescent City Airport provided an opportunity to build political support and provided a federal funding source for mitigation. Eleven acres of roads are currently in the process of being removed and wetland and dune re-established. This is the first meaningful effort to reduce habitat fragmentation in 50 years. Restoration has been made possible despite challenges because of recognition of opportunities presented by regional economic development, and with the resulting support of local elected officials and constituencies from the full political spectrum.

Human-Wildlife Conflict and Solutions

USING A FREE NON-LEAD AMMUNITION PROGRAM TO ENGAGE HUNTERS AND RANCHERS IN THE GOAL OF REDUCING LEAD EXPOSURE FOR CALIFORNIA CONDORS

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Despite recent legislation banning the use of lead for hunting in California, lead poisoning from spent ammunition still threatens the full recovery of California Condors (*Gymnogyps californianus*). In 2012, we began a free non-lead ammunition program in central California to complement other local non-lead outreach programs provided by Pinnacles National Park and Institute for Wildlife Studies. We have given away more than 3,200 boxes of non-lead ammunition in drawings and giveaways in the last four years. Survey responses indicate that the program has helped improve opinions of non-lead ammunition quality and has made many hunters more willing to use non-lead ammunition. Because the availability of non-lead rimfire is particularly limited, condors are at risk of lead poisoning when scavenging non-game

carcasses, such as ground squirrels, on private rural ranches. Satellite GPS tracking data help identify condor feeding areas, and we provide free rimfire periodically to key landowners in those areas, working with collaborators to help distribute products. Fewer condors have died of lead poisoning in central California during the last two years, indicating that this collaborative effort might be helping to reduce lead exposure for condors.

Human-Wildlife Conflict and Solutions

EXAMINING ECOSYSTEM SERVICES AND DIS-SERVICES OF BEAR DAMAGE ON HOOPA VALLEY RESERVATION

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Economic loss due to tree damage on managed timberlands by black bears (*Ursus americanus*) has been valued at several million dollars annually in the Pacific Northwest. However, damage to trees in otherwise homogeneous regenerating stands can alter forest structure and habitat that may contribute to forest wildlife diversity. To the Hupa people in northwestern California, pileated (*Dryocopus pileatus*) and other woodpecker species are considered culturally significant. We studied the relationship between bear damage to Douglas fir trees (*Pseudotsuga menziesii*) and bird community composition and structure, focusing on cavity-nesting birds such as woodpeckers. Measurements of damage to trees confirmed that bear foraging negatively affected tree growth and estimated lumber recovery. However, analyses of point counts revealed that woodpecker activity and habitat selection increased with increasing number of dead and decaying bear damaged trees. Information from this study can better inform our current understanding of the potential for bear foraging to negatively affect economic revenue, and the trade-offs which help to create habitat conditions favoring other important wildlife species. Understanding the costs and benefits of bear damage can help guide management decisions vital to forest managers both on and off tribal lands.

Human-Wildlife Conflict and Solutions

Student Paper

MAPPING, PRIORITIZING, AND INCREASING SEASONAL HABITATS FOR GREATER SAGE-GROUSE IN COLORADO

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Delineating and prioritizing seasonal habitats for wildlife is critical for successful conservation and management of at-risk populations. Many local populations of greater sage-grouse face continuing habitat loss and degradation associated with increasing energy development. In such populations, wildlife managers need accurate fine-scale maps of important seasonal habitats, guidelines for managing habitat at landscape scales, defensible methods for prioritizing habitat, and effective options for increasing habitat as mitigation for energy development. I describe current research efforts in the Parachute-Piceance-Roan population in northwestern Colorado geared toward answering pressing management and conservation questions, including: (1) results of population-level, multi-scale resource selection function analyses to model and map sage-grouse seasonal habitats, (2) application of absolute validation index analyses to identify key areas of concentrated use to help managers prioritize habitat, (3) results suggesting mixed success of efforts to improve grouse habitat through removal of encroaching pinyon-juniper.

Human-Wildlife Conflict and Solutions

Molecular Ecology and Wildlife Conservation Genetics

AMAZING ANGUIDS: THE NORTHERN ALLIGATOR LIZARD (*ELGARIA COERULEA*) AND BEYOND

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Genetic Patterns in the Northern Alligator Lizard (*Elgaria coerulea*) are examined for approximately 180 individuals with mtDNA and nuclear DNA and possible environmental causes of biogeographic patterns are examined. The Northern Alligator Lizard is then examined in context of what is known from other alligator lizards (*Elgaria* sp.) and Anguid lizards (*Anniella* sp.) in Western North America. Western North American Patterns are then expanded to briefly examine if they hold for Anguid Lizards outside of North America (*Anguinae*). The potential of climate change on Anguid Lizards are discussed in light of past biogeographical patterns.

Molecular Ecology and Wildlife Conservation Genetics

Student Paper

GENETIC ADMIXTURE IN THE SAN DIEGO FAIRY SHRIMP (*BRANCHINECTA SANDIEGONENSIS*)

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Because only 3-7% of historically present vernal pool habitat remains in coastal San Diego County, conservation efforts must prioritize both maintenance of these pools and the genetic integrity of their inhabitants. Simovich et al (2013) suggested admixture between the endemic San Diego fairy shrimp (*Branchinecta sandiegonensis*) and the versatile fairy shrimp (*Branchinecta lindahli*). They published a hybrid index based on female dorsolateral spinal patterns (which cannot be used for males and immature individuals). Using morphologically scored females from multiple source populations, we have developed a genomic hybrid index comprised of 23 single nucleotide polymorphisms that are alternatively fixed between the two *Branchinecta* species. This genomic hybrid index can be used to validate the existing morphological hybrid index, detect hybrid individuals, identify admixture in juveniles and males, and estimate natural admixture rates. Genetic assessment San Diego Fairy Shrimp populations and genetic monitoring over time will better inform management and conservation practices in the remaining coastal vernal pool ecosystems.

Molecular Ecology and Wildlife Conservation Genetics

Student Paper

SCALING-UP NON-INVASIVE GENETIC CAPTURE-MARK-RECAPTURE ESTIMATION TO THE REGIONAL SCALE: AN EXAMPLE WITH THE PACIFIC DEER HERD

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Deer numbers have been in decline across the West since the 1960s. Understanding the causes and assessing the success of management actions designed to counter them require robust estimates of abundance, which are difficult to obtain in forested regions, where aerial counts are not feasible. The use of non-invasive fecal DNA capture-recapture (CR) methods has been proposed to address this problem. Because landscapes are heterogeneous, scaling up estimates derived from localized sampling units to broader regions can pose challenges. We present an approach that uses habitat-based modeling from CR data collected from a black-tailed deer herd on their summer migratory range in the El Dorado National Forest. We selected four rectangular plots with habitat composition representative of the study area and randomly established 24 transects, 6 within each plot, for pellet collection. This design increased our ability to extrapolate density estimates to a larger study area of interest. Specifically, using the transect as the sample unit, we built and tested models relating CR-based estimates of abundance to habitat variables. Models resulted in continuous density surfaces extrapolated over the broader study area, providing region-wide estimates. Pitfalls and potential of this and other approaches to habitat modeling of density will be discussed.

Molecular Ecology and Wildlife Conservation Genetics

A VIEW INTO THE PHYLOGEOGRAPHY, HISTORICAL DEMOGRAPHY, AND SPECIATION IN THE WORLD'S MOST BASAL CANID, *UROCYON SPP*

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We investigated cross-continental and regional phylogeography of *Urocyon*, the most basal extant lineage of canid in the world. In North America, many temperate forest-associated vertebrates split into eastern and western lineages due to Pleistocene aridification in the central portion of the continent, yet currently occur in continuous distributions due to secondary contact associated with Holocene expansions. Because of the antiquity of *Urocyon* in the fossil record on both ends of the North American continent, we investigated whether gray foxes *Urocyon* exhibited a deep, cryptic divergence associated with eastern and western refugia. Sequence divergence and coalescent simulations based on mitochondrial DNA sequences from 180 foxes indicated divergence between eastern and western foxes approximately 500,000 years ago, which is comparable to that between recognized sister species within the Canidae. Second, we investigated the regional phylogeography of gray (*U. cinereoargenteus*) and island (*U. littoralis*) foxes associated with the putative western refugium. Analysis of mtDNA and microsatellites revealed some unexpected findings, prompting new questions about the origins of island foxes relative to contemporary mainland gray foxes.

Molecular Ecology and Wildlife Conservation Genetics

USE OF NON-INVASIVE DNA TO CHARACTERIZE A HIGH-SIERRA COYOTE POPULATION POTENTIALLY IMPACTING THE ENDANGERED SIERRA NEVADA RED FOX DURING FOUR YEARS OF DROUGHT

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Sierra Nevada red fox (*Vulpes vulpes necator*, SNRF) is distinguished from other subspecies by its tight association with the upper life zones of major mountain ranges in Oregon and California. One hypothesis to explain its narrow bioclimatic niche is that the characteristically deep winter snow of the subalpine zone provides a refuge, preventing establishment of breeding territories by competitively dominant coyotes. If so, climate-mediated upslope range shifts of coyotes potentially threaten persistence of SNRF populations, a danger accelerated in recent years by massive drought. During the past four years of this drought period, we collected coyote fecal DNA on a 25 km stretch of the Sierra Nevada crest encompassing the known distribution of the Sierra Nevada Distinct Population Segment of SNRF. We used microsatellites to determine the individual identity, sex, and inter-relatedness associated with each scat sample. These data were then used to determine spatial distribution and reproductive success of resident individuals, relative abundance of transient individuals, and population abundance in the vicinity of known red fox occurrences. Our results establish a baseline for coyote residence in low-snow years and provide a novel opportunity for future comparison in high-snow years.

Molecular Ecology and Wildlife Conservation Genetics

Student Paper

Policy, Management, and Human Dimensions of Wildlife Management

WHO'S ON FIRST? AN OVERVIEW OF THE KEY ROLES AND ENTITIES INVOLVED IN COMPENSATORY MITIGATION

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Compensatory mitigation for either wetlands or species has evolved over the past 10 years. The success (or failure) of these projects depends greatly on the individuals and entities involved in the long-term stewardship of a mitigation site. What roles are important in this process? Who can (legally) fill those roles? What are some of the common missteps taken in mitigation planning? How does all this coordination work? This presentation seeks to outline and discuss the various roles entities playing during compensatory mitigation projects and how these roles work together during the process of implementing mitigation.

Policy, Management, and Human Dimensions of Wildlife Management

SPECIES FUNDS: ESTABLISHING CONSERVATION FUNDS TO BENEFIT LISTED SPECIES RECOVERY

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Land acquisition is not the first priority in most Species Recovery Plans, and yet acquiring Conservation Bank (CB) credits or establishing Conservation Easements (CE) are the two most utilized methods to meet compensatory mitigation requirements for most permits authorizing incidental take. How might a Species Fund be structured and managed to benefit listed species populations? Although habitat loss figures prominently in many listed species declines, for certain species, habitat conservation may be outranked by other population limiting factors. We outline a process for setting up species specific funds to assist in financing established recovery goals already prioritized within Species Recovery Plans. Species-specific challenges surrounding standard compensatory mitigation practices are considered. Since Species Funds are only limited by fund parameters defined at the time of fund establishment, traditional mitigation approaches are not excluded by this process, and this mitigation approach can be used to aggregate funding for larger-scale CB or CE purchases.

Policy, Management, and Human Dimensions of Wildlife Management

CLIMATE CHANGE AT THE LOCAL LEVEL: HOW CLIMATE ADAPTATION CAN BE INCORPORATED INTO NATURAL RESOURCE MANAGEMENT DECISIONS

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Climate change is having profound effects on California's environment and these effects are projected to increase considerably over time. Climate-induced effects on wildlife, in combination with other factors, have the potential to greatly diminish vulnerable wildlife populations and habitats. In this presentation, we will discuss numerous opportunities to consider climate change when making natural resource management decisions at the local, regional, and state levels. We will focus particularly on ways that climate vulnerability assessments and adaptation planning can influence management of lands, water, fish, and wildlife, using the existing legal and policy framework and through new tools and policy mechanisms. Several examples of how the practices of climate vulnerability assessment, adaptation strategies, and climate action plans are influencing natural resource management will be described.

Policy, Management, and Human Dimensions of Wildlife Management

ASSESSING CLIMATE CHANGE VULNERABILITY OF CALIFORNIA'S VEGETATION: RESEARCH RESULTS AND APPLICATION TO CONSERVATION PLANNING

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The California Department of Fish and Wildlife (CDFW) recognizes that climate change is a major challenge to the conservation of California's natural resources and is taking an active role in planning for and responding to this challenge. Effectively addressing climate change requires an understanding of the major risks that it poses to fish, wildlife, and habitats in California. In 2015, in association with the State Wildlife Action Plan update, CDFW partnered with the University of California, Davis to assess the vulnerability of natural vegetative communities state-wide to climate change. Vulnerability was determined by using a detailed map of the spatial patterns of California's vegetation community types, and examining how climate conditions will change at those locations. Sixteen of 29 natural vegetation community types in California were found to be highly or nearly highly vulnerable to four alternate projected climates by the end of this century. Efforts are currently underway to incorporate the results of this study into CDFW conservation planning activities. Utilizing the best available science for climate adaptation planning will help to ensure successful conservation and management of California's valued natural resources.

Policy, Management, and Human Dimensions of Wildlife Management

Poster Session

MULTI-METHOD AND MULTI-MODEL DIFFERENCES IN CONNECTIVITY

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The ability to model connectivity has skyrocketed in recent years, but, as with all models, each is fraught with inherent errors and restrictions. Connectivity is typically modeled by creating landscape-cost surfaces based off of expert opinion, but this level of subjectivity often makes recreation of studies difficult. While a few studies have tried to use niche-based modeling to parameterize cost maps, these have often performed poorly compared to expert-driven models. Methodology for calculating connectivity also varies: least cost paths (LCP) model a single route between populations while Isolation by Resistance (IBR) modelling incorporates multiple pathways of dispersal. Here, I present preliminary models of connectivity for the endangered giant kangaroo rat (*Dipodomys ingens*) and note the variance between niche-based driven and expert opinion based models as well as the difference between LCP and IBR modeling.

Poster Session

THE EFFECTS OF OCEAN NOISE ON WHITE-CROWNED SPARROW SONG STRUCTURE

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Recent research has established that anthropogenic noise affects bird song structure due to behavioral adjustments, but does natural background noise affect song structure in the same way? As anthropogenic noise increases in urban environments, a number of species of birds will increase the minimum frequency of their songs and therefore reduce the frequency bandwidth. This is relevant because it has been shown that there is a performance frontier in relation to song bandwidth and trill rate. Reduction in bandwidth reduces performance value which results in lower responsiveness to adjusted songs and reduced mating opportunities (Luther, Phillips and Derryberry, 2015) Our study investigates the relationship between amplitude of ocean noise on White-crowned Sparrow song structure, focusing on the trill, and vocal performance in Montaña de Oro State Park, on the Central Coast of California. Individuals in areas with higher amplitudes of ocean noise have a higher minimum trill frequency and a reduced trill bandwidth. Our results suggest that White-crowned Sparrows are behaviorally adjusting their songs in response to natural background noise similarly to urban birds and may face the same challenges such as having fewer mating opportunities.

Poster Session

Student Paper

SEASONAL HOME RANGE AND HABITAT SELECTION OF PORCUPINES IN A COASTAL DUNE FOREST

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Understanding wildlife-habitat relationships is critical for conservation and management and for predicting how species' ranges will shift under climate change. For generalists, these relationships can be highly variable, necessitating fine-scale habitat selection studies across spatial and temporal scales. We studied home ranges and habitat selection of a widely distributed generalist herbivore, the North American porcupine (*Erethizon dorsatum*). Porcupines have undergone recent, unexplained decline in California, yet very little is known about their ecology at this edge of their range or in coastal areas in general. Furthermore, although porcupine diet and behavior are known to have a strong seasonal component, few studies have compared home range and habitat use between summer and winter. We captured and radio-collared 14 porcupines in Tolowa Dunes State Park in Del Norte County, California, in summer 2015. Here, we present results from summer, fall, and winter tracking in order to understand habitat selection at the home range and within-home-range levels. This research will (1) help us understand spatiotemporal changes in habitat

relationships in this generalist species, and (2) inform future research and management of the porcupine in light of its recent decline.

Poster Session

Student Paper

DROUGHT-RELATED GIANT KANGAROO RAT DECLINE IN THE CIERVO-PANOCHÉ

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The ongoing, severe drought is predicted to have negative consequences for a suite of sensitive species in California. One such species, the giant kangaroo rat (*Dipodomys ingens*, GKR), has shown dramatic population fluctuations in relation to precipitation over the past four decades. Here we present results from trapping efforts in the Ciervo-Panoche Natural Area, San Benito County from 2011-2015. We found a decline in density estimates and trap success over that time; we also documented a shift in occupancy from drier, more southerly sites to wetter, northern sites. A decline in GKR density coincided with an increase in small mammal community diversity.

Poster Session

SUMMER DIET OF COASTAL NORTH AMERICAN PORCUPINES (*ERETHIZON DORSATUM*) IN TOLOWA DUNES STATE PARK: A MICROHISTOLOGICAL APPROACH

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Obtaining a thorough, quantitative understanding of how individuals in a species respond to different environmental variables is critical when attempting to understand their use and selection of habitats. The North American porcupine (*Erethizon dorsatum*) is a widely studied generalist herbivore thought to select habitat based on predation risk and food availability. Despite this, no quantifiable diet study has been conducted on the porcupine to explore this aspect of their habitat selection; only observational studies have been used to describe their diet. Here we present the results of a microhistological study aimed to quantify the summer diet of 13 North American porcupines in Tolowa Dunes State Park. Plant species with the highest percent abundance represented in fecal material were coastal willow (*Salix hookeriana*), pacific willow (*Salix lucida*), wild cucumber fruit (Marah sp.), and waterpepper (*Polygonum hydropperoides*). Attaining a comprehensive, quantitative understanding of porcupine summer diet composition is relevant to local research of this species, especially considering their recent decline in Humboldt County, California. Results from this study will provide valuable information to those studying the decline, habitat selection, or foraging ecology of porcupines in this region.

Poster Session

Student Paper

EFFECT OF DISTANCE TO FOREST ON MESOCARNIVORE ACTIVITY IN NORTHERN CALIFORNIA COASTAL DUNES

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The Ma-le'l coastal dunes of northern California have been affected by the invasion of dense European beachgrass (*Ammophila arenaria*). In response, the U.S. Fish and Wildlife Service (USFWS) and the Bureau of Land Management (BLM) have removed beachgrass in an attempt to restore native ecosystem function. Mesocarnivores play vital roles in trophic webs, and previous research has suggested that they are more active in restored dunes than in areas with dense beachgrass. However, distance to nearby coastal dune forests could affect mesocarnivore activity and may have

confounded previous work. We conducted an observational study using remote cameras and found the detection rate mesocarnivores declined with distance to forest. Our most frequent detections were of striped skunks (*Mephitis mephitis*), gray foxes (*Urocyon cinereoargenteus*), and feral cats (*Felis catus*). Our findings suggest management of the coastal dune ecosystem should recognize both the density of cover of invasive grass and the proximity to forested habitat that may serve as den or resting sites for mesocarnivores.

Poster Session

Student Paper

COMPARISON OF METHODS TO ESTIMATE FLEDGING RATES FOR CALIFORNIA LEAST TERNS

Jeanette Boylan; San Diego Zoo Institute for Conservation Research; 15600 San Pasqual Valley Rd., Escondido, CA, 92027; 214-337-8557; jboylan@sandiegozoo.org; **Katrina Murbock**; **Travis Wooten**; **Rachel Smith**; **Maggie L. Post**; **Lisa Nordstrom**; **Ron Swaisgood**

Fledgling numbers are notoriously difficult to determine for California Least Terns (*Sternula antillarum browni*) because of the mobility of chicks soon after hatching and the difficulty of finding signs of predation. We compared two new methods for estimating fledging rates: use of small enclosures and use of radio tags on chicks. The enclosures were 60 x 60 or 90 m, constructed of 15-20 cm high fencing, and erected before the nesting season. The small radio tags were attached to the intrascapular region of chicks at ~ 5 days old. After trialing both methods and comparing to the results from traditional visual surveys, the use of small enclosures proved to be the better option. The radio tags had two primary drawbacks: young chicks in the nest were too small to attach the transmitters and the tags frequently fell off. A critical component of the enclosure design was the requirement to be large enough to encompass a sufficient number of nests. In addition to obtaining information on yearly chick survival, data on growth was also obtained which can be compared across years to investigate factors influencing growth and survival.

Poster Session

EXPLOITATION, INTERFERENCE, AND NICHE PARTITIONING: COMPETITION AND COEXISTENCE IN A RODENT COMMUNITY

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The Pacific pocket mouse (*Perognathus longimembris pacificus*) is a federally listed endangered species and the Los Angeles pocket mouse (*P. l. brevinasus*) is a Species of Special Concern in California. Each little pocket mouse subspecies is the smallest member of its respective rodent community in Southern California coastal sage scrub or chaparral habitat. Multiple species that occupy similar niches in a community compete directly and indirectly for shared resources. Differences between species in interference competition ability that counteract a difference in exploitative competition ability may allow species to achieve stable coexistence in these habitats. Through a series of experiments, we are investigating the mechanisms that allow these small, specialist foragers to maintain stable populations in their respective communities of larger generalist competitors. In Experiment 1, we study interference competition and interspecific territoriality through staging dyadic encounters in the field. In Experiment 2, we investigate exploitative competition through cache pilfering trials. Finally, we are conducting monthly monitoring to understand both spatial and temporal niche partitioning. Through these studies we aim to clarify the interspecific relationships that structure these small mammal communities and maintain species diversity.

Poster Session

Student Paper

CAVITY-NESTING BIRD HABITAT UTILIZATION IN RESTORED RIPARIAN WOODLANDS OF THE SACRAMENTO VALLEY

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Remnant and restored riparian woodland habitat are important to cavity-nesting bird species (CNB). I performed vegetation and cavity surveys in both habitat types to assess potential habitat usage by CNB and compare colonization rates between differently aged restored woodlands. The proportion of trees with available nesting substrate and snags was similar in both old restored (aged 16-19 years) and remnant forests, but more cavities were excavated in old restored forests than remnant. The high number of cavities in remnant forests was attributed mostly to natural cavities that occur in very mature trees.

Poster Session

DO CALIFORNIA HIGHWAYS ACT AS BARRIERS TO GENE FLOW FOR GROUND-DWELLING MAMMALS?

Amanda Coen; University of California Davis; One Shields Avenue, Davis, CA, 95616; 818-324-0207; aecoen@ucdavis.edu; **Andrea Schreier**; **Fraser Shilling**

Maintaining connectivity among populations fragmented due to human-induced landscape change is an important challenge in California's increasingly impacted landscape. Roads, crucial for connecting urban centers, can act as significant barriers to wildlife dispersal, but their effects on genetic connectivity of populations vary, likely with intensity of use, and are generally difficult to quantify. Major multilane highways provide a range of traffic volumes, allowing for examination of the impacts of highway use on genetic connectivity. We examined populations of coyotes (*Canis latrans*) along SR 50 and I-80 in the Sierra Nevada Foothills and I-580 and I-680 in the Bay Area to determine whether these highways act as barriers to gene flow between bisected populations. DNA from fecal samples collected along each side of the highways was sequenced for species confirmation and genotyped with microsatellites. We will examine regional genetic structure using population assignment testing and pairwise FST estimates to determine the degree of connectivity across and alongside the study highways. Recent federal transportation law encourages development of sustainable transportation systems, including reduced impacts on wildlife connectivity. Understanding how California highways impact wildlife will aid transportation agencies in incorporating and prioritizing mitigation strategies.

Poster Session

Student Paper

USING LIGHT DETECTION AND RANGING (LIDAR) TECHNOLOGY TO CHARACTERIZE CALIFORNIA SPOTTED OWL HABITAT IN THE CENTRAL SIERRA NEVADA (U.S. FOREST SERVICE, PACIFIC SOUTHWEST REGION, REMOTE SENSING LAB AND TAHOE NATIONAL FOREST)

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Land managers are faced with identifying preferred habitat for the California spotted owl for environmental analysis and forest restoration, but existing vegetation map products over-generalize the existing condition. These products rely on average forest stand conditions for canopy cover density and size classes (i.e. California Wildlife Habitat Relationship Classification System (CWHR)) which may not accurately reflect forest canopy and structural characteristics used by the owl for foraging and reproduction. Additionally, the remote sensing technologies used to generate these map products cannot effectively characterize fine-scale habitat structures important to the owl. LiDAR was used to assess canopy densities, tree size distribution, canopy strata, successional stage, and spatial arrangement of early seral habitats, individual trees and groups of trees on ecologically meaningful topographic positions. This study was conducted on the Tahoe National Forest in the central Sierra Nevada where spotted owls have successfully reproduced. Results show much more variability around nest sites and within protected activity centers and home range core areas than previously understood, primarily due to assessments that were limited in scope and scale.

Poster Session

EFFECTS ON WATERSHED FUNCTION WITH CHANGES IN PLANT FUNCTIONAL GROUPS ACROSS IMPAIRED WATERSHEDS ON THE ANGELES NATIONAL FOREST

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This study collected vegetation composition inventory, soil aggregate stability measurements, and geometric measurements of vegetation to quantify and detect the potential changes in hydrological function of impaired watersheds on the Angeles National Forest, driven by frequent fire return intervals and infestation of non-native herbaceous vegetation. Wieslander VTM Mapping provides a historical long-term indication of vegetation composition in 1939. The vegetation composition inventory conducted in 2014 will be compared with this 1939 and 1969 composition, indicating changes across these watersheds over time. Geometric dimensions were obtained to calculate aboveground biomass available for potential fires in the near future while providing a baseline for monitoring shrub land growth rates on these sites. The 2002 Copper Fire, which occurred in the San Francisco watershed, burned the majority of coastal sage scrub and chaparral vegetation that was present. This fine-scale evaluation of post-fire recovery over time will enable the identification of mechanisms, which have reduced shrub-land growth and regeneration recovery rates while indicating restoration needs.

Poster Session

PG&E LAND CONSERVATION COMMITMENT PROGRAM

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Pacific Gas and Electric Company (PG&E) is on its way to becoming one of the largest conservation landowners in California through implementation of its Land Conservation Commitment (LCC). Working with local land trusts, PG&E is utilizing conservation easements to permanently protect the natural resources, habitat, recreation, and cultural resources of its Hydro watershed lands. Once the LCC is implemented, over 140,000 acres of land in the Sierra and Cascades will be protected.

Poster Session

CONSERVATION OF THE WESTERN GRAY SQUIRREL IN GRIFFITH PARK THROUGH NON-INVASIVE GENETIC SAMPLING WITH MTDNA AND MICROSATELLITE ANALYSIS

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Local extinction of Western gray squirrels (*Sciurus griseus*) (WGSs) is due to loss or fragmentation of their habitat, potential competition between Eastern fox squirrels (*Sciurus niger*), and other anthropogenic disturbances. To evaluate how these factors affect a population of WGSs in Griffith Park (GP), we are recording the species' distribution and characterizing their genetic diversity. The level of genetic diversity in the WGS population in GP is compared to that of populations in four other areas: the Santa Monica Mountains (SMMs), Monrovia Canyon (MVC), Bonelli Park (BP), and Rancho Santa Ana Botanic Gardens (RSABG). Hairtubes were constructed and deployed in all five regions to collect hair samples of WGSs. DNA was extracted from those samples and by using mtDNA and microsatellite markers, the genetic diversity is being determined. Thus far, the haplotype found in GP is also found in BP and RSABG but not in the SMMs. A haplotype found in the SMMs was also found in BP. Preliminary genotyping of individuals was successful using 10 microsatellite loci. Continued sampling to assess the level of genetic diversity will allow predictions regarding the viability of the population of WGSs in GP and will reveal important implications for their conservation.

Poster Session

ANNUAL VS. PERENNIAL: THE USE OF RADIO TELEMTRY TO INFORM ADAPTIVE MANAGEMENT STRATEGIES FOR WESTERN POND TURTLE, *ACTINEMYS PALLIDA*, WITHIN RIVERSIDE COUNTY.

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The southern western pond turtle (*Actinemys pallida*) is the only native freshwater turtle found in Southern California and is currently experiencing population declines through most of its historic range. Understanding the movement patterns and seasonal habitat use of pond turtles can help land managers make better informed adaptive management decisions. Conservation land owned by the Regional Conservation Authority (RCA) includes properties that are occupied by western pond turtle which contains both ephemeral ponds and perennial creeks. Using radio telemetry we tracked turtles to observe and document possible differences in habitat use between the ponds and creeks. We found that turtles located in the ponds estivated along the banks of the creek under vegetative cover, whereas turtles in the creek system had a general upstream movement and stayed in the aquatic environment. Using this information we are able to plan specific management strategies for the pond turtle as well as determine appropriate land use and future conservation needs within Core Areas and specific habitat types.

Poster Session

AIRCRAFT DISTURBANCE TO COMMON MURRES (*URIA AALGE*) AT A CENTRAL CALIFORNIA BREEDING COLONY

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Devil's Slide Rock (DSR), hosts a Common Murre (*Uria aalge*) colony which is close to San Francisco Bay and the Half Moon Bay airport. This colony has many challenges because of its proximity to potential disturbance sources. Historically, low-flying aircraft have posed a major threat to nesting seabirds on DSR. To assess the effect of timing and aircraft attributes, we constructed and ranked several multinomial log-linear models that included data from 2008 to 2014. Our top model included seven variables: year, reproductive timing, start time, aircraft type, aircraft category, altitude and distance; as well as the interactions between aircraft type and aircraft category, and between altitude and distance. The relative risk of disturbance varied from year to year, with 2010, 2011, 2013 and 2014 exhibiting a greater risk of disturbance than 2008. Disturbance was more likely during the pre-egg lay period and post-chick hatch period than during incubation. Helicopters were more likely to cause disturbance than fixed-wing aircraft. Displacement/flushing was more likely to occur at low altitudes and close distances. Our results support implementation of overflight regulations above DSR, similar to those implemented in other coastal areas.

Poster Session

GENETIC DIVERSITY AND POPULATION STRUCTURE OF THE RIPARIAN BRUSH RABBIT (*SYLVILAGUS BACHMANI RIPARIUS*)

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California's San Joaquin Valley has faced dramatic changes in land composition over the last century, offering an example of a highly altered system with few isolated native remnants. Over time, changes in habitat size and connectivity can impede gene flow between populations of species and augment genetic drift resulting in long-term evolutionary consequences. Such is the case for the riparian brush rabbit (*Sylvilagus bachmani riparius*), a subspecies of brush rabbit endemic to the San Joaquin Valley. *S.b. riparius* has experienced substantial declines due primarily to

habitat loss and fragmentation but also periodic flooding, drought, and wildfire, resulting in its listing as an endangered species. We identified current genetic diversity and population genetic structure of five remnant *S.b. riparius* populations and two populations of the neighboring *S.b. macrorhinus*. We find moderate levels of genetic diversity within the populations. Bayesian clustering indicates the presence of three distinct genetic clusters corresponding to the geographic locations of the populations, though isolation by distance is only modestly supported by these data. As such, we anticipate that habitat configuration and landscape features play important roles in determining the distribution of genetic variation, and are central to the success of future recovery efforts.

Poster Session

Student Paper

KEEPING THE LIGHTS ON

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There are 20,000 PG&E employees bringing safe and reliable energy to 15 million people between the Pacific Ocean and Sierra Nevada mountains, from Eureka to Bakersfield. Energy is delivered via 141,000 circuit miles of electric lines and 42,000 miles of natural gas pipelines. PG&E has been in operation since 1852, so most lines were installed prior to enactment of the state and federal endangered species acts. Today, day-to-day operations and maintenance requires consideration of sensitive plants, wildlife, habitat, and stream sources, such as wetlands, marshes, ponds, lakes and springs. To address where PG&E operations and maintenance activities intersects with sensitive resources, PG&E employs a team of 40 subject matter experts that guide project teams through the regulatory process with guidance from the Biology Program. The program provides well-informed advice, guidance, training and procedures to assist with effective, efficient and consistent biology and natural resource permitting. Development of guidance and procedures helps teams achieve regulatory compliance in a consistent, cost effective manner that is scientifically based and demonstrates environmental leadership. Guidance on Section 404 of the Clean Water Act is one example of guidance prepared by PG&E's Biology Program.

Poster Session

EFFECT OF RODENT SEED PREDATION AND APPARENT COMPETITION IN NATIVE DUNE ECOSYSTEMS

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Invasive species apparently compete with native species by increasing abundance or altering behavior of native consumers, and causing increased granivory or herbivory on native species. Coastal dune communities in Humboldt County, California are heavily invaded by European Beachgrass (*Ammophila arenaria*) and yellow-bush lupine (*Lupinus arboreus*), and experienced consequent major changes in composition despite efforts to control these exotics. We tested whether these invaders apparently compete with two native plants, silky beach pea (*Lathyrus littoralis*) and yellow sand verbena (*Abronia latifolia*), using seed addition plots in dune areas alternately dominated by a native plant assemblage, lupine, and beachgrass. We excluded rodents from beach pea and sand verbena plots matched with a paired control across these three plant community types; if beachgrass and lupine apparently compete with beach pea sand verbena, we expected greater effects of rodent exclusion on germination and seed removal in invaded areas. Rodent exclusion decreased seed predation and increased germination similarly across all three community types for beach pea, but not for sand verbena (few sand verbena germinated, limiting our inference for this species). Thus, granivory may limit recruitment of native plants, especially beach pea, yet we did not detect clear evidence of apparent competition with invaders.

Poster Session

DESIGNING A WILDLIFE ENCOUNTER AND HEALTH DATA MANAGEMENT SYSTEM

Mitchel Gritts; Nevada Department of Wildlife; 6980 Sierra Center Parkway, Suite 120, Reno, NV, 89511; 7756881539; mgritts@ndow.org; **Peregrine Wolff**; **Cody Mckee**; **Bonnie Weller**; **Chris Morris**

Wildlife encounter and health data collection at the Nevada Department of Wildlife (NDOW) has historically relied on the individual efforts of wildlife biologists. Centralized, consistent data management was non-existent, and the existing data management efforts were inefficient and distributed across the agency using a variety of file formats and software. Since 2010 the NDOW Health Lab has processed 1786 live, 551 dead, and 350 harvested animals across the state, resulting in over 13,000 disease test results. These data were stored in non-standardized spreadsheets and PDF files. In an effort to increase reproducibility and develop robust data access and analysis practices we designed a wildlife encounter and health data management system. This system allows us to combine wildlife health data, capture information, and movement and encounter locations to more easily access and analyze the data in the context of complex management questions. We used R to interface with the system to develop customized data reporting, statistical analysis, and data visualization tools. We suggest a general framework for proper wildlife health and encounter data management practices, development of data management systems with easy to use tools, interfacing with open source software, and designing simple web applications to successfully manage and distribute data.

Poster Session

SPECIES RECOVERY VS. SPECIES PROTECTION - MAXIMIZING BENEFITS

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Listed species Recovery Plans prioritize research and management actions needed to support recovery, but do not identify how those actions will be funded. In contrast, species protection mechanisms, such as avoidance and minimization measures, or AMMs, and compensatory mitigation measures identified in discretionary permits, require secured funds from project applicants. The cost of implementing permit-required AMMs can be exorbitant, but the necessity of some measures is not scrutinized or reviewed for effectiveness in avoiding or minimizing take. A few commonly applied AMMs, with examples of associated implementation costs, will examine how AMM dollars might be better spent. AMMs are not conservation measures nor are they identified in any Species Recovery Plans; and yet millions of dollars are spent every year - dollars that could be funding priority actions identified in Species Recovery Plans.

Poster Session

IMPACTS OF SOLAR ENERGY ON PROTECTED AREAS AND LAND COVER CHANGE

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Decisions determining the use of land for energy are vital as land scarcity, the need for ecosystem services, and demands for energy generation are increasing globally. Utility scale solar energy (USSE; i.e., megawatts) development requires large quantities of land; however, studies quantifying their effects on land cover change and protected areas are limited. We assessed siting impacts of >160 installations by technology type, area (km²), and capacity (MW) within the global solar hot spot of the state of California. Additionally, we used a multiple criteria model to quantify each installation according to environmental and technical compatibility. Last, we evaluated installations according to their proximity to protected areas, including inventoried roadless areas, endangered/threatened species habitat, and federally protected areas. We found the majority of USSE is sited in shrublands and scrublands followed by croplands and pastures. Less than 15% of installations are sited in "compatible" areas. The majority of "incompatible" installations are sited far from existing transmission infrastructure, and all installations average 7 and 5 km from protected areas, for photovoltaic and concentrating solar power, respectively. Where energy, food, and conservation goals intersect,

environmental compatibility can be achieved when resource opportunities, constraints, and trade-offs are integrated into siting decisions.

Poster Session

CURRENT DATA NEEDS OF THE CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE'S SPOTTED OWL OBSERVATIONS DATABASE

Kate Whitney Keiser; California Department of Fish and Wildlife; 1416 9th Street, Suite 1266, Sacramento, CA, 95814; 916-445-5006; kate.keiser@wildlife.ca.gov;

The Northern Spotted Owl (*Strix occidentalis caurina*, NSO) and the California Spotted Owl (*Strix occidentalis occidentalis*, CSO) are California Species of Special Concern. The NSO is listed as Federally Threatened and is under review for protection under the California Endangered Species Act as of December 2013. The CSO is under review by the US Fish and Wildlife Service as of September 2015. Both subspecies are tracked by the California Department of Fish and Wildlife (CDFW) in the Spotted Owl Observations Database. The Database was created in 1973 and provides a centralized location for the collection, review, and reporting of Spotted Owl data by biologists, foresters and managers in government agencies, non-profit organizations, and the private sector. CDFW receives numerous datasets from a wide variety of contributors. However, data gaps exist across the state, especially in the CSO range. To fill these gaps we encourage anyone with Spotted Owl data to submit their datasets to CDFW for inclusion in the Database. Additionally, CDFW manages the Barred Owl Observation Database to track the encroachment of the Barred Owl into Spotted Owl habitat. Therefore, we also encourage individuals to submit their Barred Owl data.

Poster Session

CALIFORNIA-NEVADA GOLDEN EAGLE OBSERVATIONS DATABASE: CALL FOR DATA

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The CA/NV Golden Eagle Working Group (GEWG) was established in 2011 to provide a forum for state and federal agencies, nongovernmental organizations, researchers, landowners, and other interested parties to discuss and coordinate activities surrounding Golden Eagle inventory, monitoring, research, and conservation efforts. The GEWG Data Management Subgroup was initiated based on the need for comprehensive data on Golden Eagles in California and Nevada. Over the last two years this subgroup along with California Department of Fish and Wildlife (CDFW) Biogeographic Data Branch staff and USFWS staff have led an effort to develop the Golden Eagle Observations Database. This species-specific database houses all types of observations, including nesting, foraging, and roosting data. Currently the database contains over 3,900 records. CDFW and USFWS staff continue to compile data with the goal of creating the most robust database and determining where data gaps may occur. To help meet this goal, we are asking individuals with Golden Eagle data to submit records to CDFW. For data submissions, the Golden Eagle Database Submission Template can be accessed online from the CDFW website. Alternatively, Golden Eagle data can be submitted using the CNDDDB Online Field Survey Form, also available online via the CDFW website.

Poster Session

RESULTS OF WILDLIFE MONITORING ON THE TAH.MAH.LAH PROJECT FROM 2007-2014: RESPONSES OF WILDLIFE TO SMALL SCALE HABITAT RESTORATION

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From 2007 to 2014, wildlife monitoring was conducted by biologists with Coast Ridge Ecology and TRA Environmental Sciences, with assistance from HT Harvey and Associates for the Tah.Mah.Lah• project, a Green Building residential home project in Portola Valley, California. The purpose of the monitoring was to inventory and track changes to local wildlife species composition on the 2-acre property before, during and after home construction and habitat restoration activities. Camera traps, point counts and cover board arrays were set up to monitor mammals, birds and reptiles/amphibian species, respectively. While mammal and bird species showed no significant change during the monitoring period, reptile and amphibian encounter rate and species diversity showed a decrease during the construction period and an increase during the post-construction/restoration period. We show that due to a number of factors, small-scale restoration to offset construction projects can be effective in increasing abundance and diversity of herpetofauna, and demonstrate that they may be useful indicators of habitat quality.

Poster Session

CHROMOSOMAL AND MORPHOMETRIC CHARACTERISTICS, RANGE, AND HABITAT ASSOCIATIONS OF *PEROGNATHUS INORNATUS* FROM THE WESTERN MOJAVE DESERT

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The San Joaquin pocket mouse (*Perognathus inornatus*) is a California endemic currently comprising three subspecies (*inornatus*, *neglectus* and *psammophilus*). From 1991-2015, we investigated the cytogenetic and morphometric characteristics and habitat associations of *P. inornatus* at 63 locales throughout the western Mojave Desert. Karyotypes were prepared by Dr. James L. Patton (emeritus curator, MVZ Berkeley, CA) and all were characterized by a diploid complement of chromosomes ($2n = 52$) not previously described. Principal components analysis indicated that the 52-chromosome form was closely associated with *P. i. neglectus* ($2n=56$) but strongly divergent from *P. i. inornatus* ($2n=50$) and *P. longimembris* ($2n=56$). *P. inornatus* was significantly larger in total length, head-body length, hind foot length and weight than *P. longimembris*. It was found primarily on well-drained, coarse soils in Creosote Bush Scrub, Saltbush Scrub, Joshua Tree Woodland, Rabbitbrush Scrub and Juniper Woodland at elevations between 2,600-3,600 feet. The taxonomy of *P. inornatus* is unresolved, and it is the only species in the genus that includes more than one diploid number. It is important to view the 52-chromosome form independently for conservation purposes, since it occupies a small geographic area subjected to increasing habitat loss from renewable energy development and other human-related activities.

Poster Session

COCCIDIOIDOMYCOSIS IN RESCUED MARINE MAMMALS ALONG CALIFORNIA'S COAST

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Coccidioidomycosis is the number one fungal infection among stranded marine mammals in California. However, nothing is known about differences in prevalence of the disease in pinnipeds, how the disease affects rehabilitation of stranded animals, or if some age groups are more vulnerable than others. Arthroconidia from the soil-dwelling fungal pathogen *Coccidioides* spp. can become airborne when soil is disturbed in endemic areas and subsequently transported by the wind to non-endemic areas, including California's coast. We hypothesize that California sea lions and other pinnipeds rescued by Marine Mammal Care Centers (MMCs) closest to the Southern San Joaquin Valley and the Western Mojave Desert, known as a hot spot for coccidioidomycosis, will have a higher prevalence of the disease

compared to animals rescued further north. We examined serum samples from animals with respiratory problems, which were rescued at several MMCs. By performing immunodiffusion assays, we detected cocci-specific IgM in 13% (n=9) of blood sera from predominantly adult and subadult California sea lions rescued at the facility in San Pedro, California between 2014 and 2015 (n=68), indicating acute coccidioidomycosis. To determine if exposure is different between rescue locations and age class, samples are currently being analyzed from additional marine mammal rehabilitation centers.

Poster Session

INVESTIGATING THE POSSIBILITY OF CHANGES IN THE GROWING SEASON OF *ASCLEPIAS FASCICULARIS* DUE TO CLIMATE CHANGE.

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Narrow-leaved Milkweed (*Asclepias fascicularis*) is a native, perennial herb distributed along the west coast from Baja California to Washington. It is normally emergent between March and October and experiences die-back in the winter. It is well known for being one of the larval host plants for Monarch butterflies (*Danaus plexippus*). We explore whether changes in phenology are predicted under future climate models, and speculate on possible impacts to monarch breeding phenology. Specifically, we use the maximum entropy habitat modeling software MaxEnt, climatic data from BioClim's Global Climate Data database and, plant location data from the UC Jepson Consortium of Herbaria, to investigate possible changes in the growing season and growing range of *A. fascicularis* under future predicted climatic conditions. The results show that, over the next few decades, potentially suitable growing conditions are likely to occur in every month (including months where the plant is currently dormant). This is especially true for the immediate coast, which is the same area where many Monarchs congregate to overwinter. The results suggest a temporal and/or geographic shift in Monarch's breeding habits, with the potential for a naturally occurring year-round breeding population.

Poster Session

EFFECTS OF DOUBLE INFECTIONS ON PARASITIC FLATWORM REPRODUCTIVE CASTES

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Studies show that several species of parasitic flatworms that infect the marine snail, *Cerithidea californica*, have a division of labor where individuals are specialized for either reproduction (reproductives) or defense of the colony (soldiers). Research has focused on understanding the morphology, distribution, and behavior of parasites in the more common, single infections. Studies have shown that these parasites will kill each other when a snail is simultaneously infected with two species, but little is known about these interactions. Here, we provide insight into these interactions by examining the morphology and distribution of these organisms in doubly infected snails. These double infections are a snapshot of a transition that is occurring, since two different parasite species typically don't share their snail host for an extended period of time. Consistent with our predictions, the subordinate species is displaced; fewer soldiers are present and the reproductives look unhealthy. The incoming, dominant species has many immature parasites and is beginning to establish an infection. These seemingly insignificant creatures are important when it comes to the make up of an ecosystem; they take up resources and affect the health and survival of hosts in estuarine communities.

Poster Session

INSTITUTE FOR WILDLIFE STUDIES PREDATOR MANAGEMENT TECHNIQUES FOR THE PROTECTION OF FEDERALLY LISTED BEACH NESTING SPECIES

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Predation of nests and nestlings by native and non-native predators remains a major area of concern for the recovery of both the federally endangered California Least Tern (*Sternula antillarum browni*) and federally threatened Western Snowy Plover (*Charadrius nivosus nivosus*) populations. Previous studies have shown that predator control programs initiated to protect beach nesting shorebirds from both avian and mammalian predators have been successful in increasing hatching and fledging success. We focused on using non-lethal techniques, such as translocation and conditioned taste aversion, for management of native predators, as well as lethal methods directed primarily at non-native predators found at Naval Base Coronado and Marine Base Camp Pendleton. We used a variety of trapping and hunting techniques to remove a total of 484 potential mammalian and 314 avian predators of terns and plovers at the two military installations during the 2012-2015 nesting seasons. We are exploring new non-lethal control methods that can be used to deter native predators occupying nesting grounds of sensitive shorebird species, which may reduce the amount of lethal control necessary to effectively manage predators for the recovery of listed shorebird species.

Poster Session

SEED PREFERENCE OF THE NATIVE CONSUMER, *PEROMYSCUS MANICULATUS*, IN A COASTAL DUNE COMMUNITY

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Granivory can dramatically alter the composition and diversity of plant communities, and the dietary preferences of granivores may have major impacts on these effects. This phenomenon is not well-studied or understood, but has the potential to play a vital role in mediating the process of exotic plant invasion. We evaluated seed preference of a native rodent consumer, *Peromyscus maniculatus*, in a coastal dune community by conducting cafeteria-style feeding trials. Evenly mixed seed trays of three native plants, *Lathyrus littoralis*, *Calystegia macrostegia*, and *Bromus carinatus*, and one exotic plant, *Lupinus arboreus*, were used to test for preference of seed types. Feeding trials were conducted in both native- and exotic-dominated habitats to test for differences in preference between habitat types. Seed preference of native consumers may play a role in biotic resistance of dune communities to invasion, or alternatively, aid in establishment of exotic plants by increasing granivory on natives. Understanding the mechanisms of granivore influence on invasion dynamics will provide insight into how seed predation affects plant community assembly in a sensitive dune system.

Poster Session

NON-BREEDING SEASON BEHAVIOR OF THREATENED SAN CLEMENTE BELL'S SPARROW (*ARTEMISIOSPIZA BELLI CLEMENTEAE*)

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The San Clemente Bell's sparrow (*Artemisiospiza belli clementeae*) is a federally threatened non-migratory subspecies endemic to San Clemente Island, California. The US Navy has monitored the breeding population over a decade, but until 2013, no formal research was conducted during the non-breeding season. Published accounts of similar mainland species and previous anecdotal non-breeding season observations from San Clemente Island described sparrows ceasing singing and leaving breeding territories to form loose roaming flocks. From July-December, 2013-2015 we monitored non-breeding season behavior on 402 study plots ranging in size from 4-22 ha. We recorded data including

frequency and timing of singing, flocking, and territorial behaviors, as well as locations of banded adults. We recorded 3,366 encounters of Bell's sparrows. We found 202 (6%) in flocks of ~4 and 150 (4.5%) singing males. We found no relationship between frequency of these behaviors and date, rainfall, or relative Bell's sparrow density. We found 78% (91 of 116) of banded adult observations were <350m from their breeding season locations. Our findings suggest less flocking behavior, greater seasonal philopatry, and more singing during the non-breeding season than expected. This information will be used to inform future monitoring and population recovery efforts.

Poster Session

PREFERENTIAL ABIOTIC DIFFERENCES OF HERPTOFAUNA IN REGARDS TO WOOD OR METAL COVER BOARDS

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The general reasons as to why certain cover boards of a different material are more effective than others in capturing reptiles and amphibians are still misunderstood. To discover preferential factors leading to herptiles following certain behaviors, abiotic factors of soil acidity, soil moisture, and ambient temperature were recorded at various intervals underneath metal and wood cover board pairs, while noting herptile presence. This study took place at a field site on the Chorro Creek Preserve of San Luis Obispo, California. The data was captured and compared for significant differences and only the abiotic factor of soil moisture showed change while temperature and acidity had the promise of significance in the future with continued study and increased rainfall. Species occurrence, while minimal, also showed the possible trend of wood cover board preference over metal, but cannot be confirmed until further studies and more data collection has been conducted.

Poster Session

URBAN WILDLIFE TRACKING AT CALIFORNIA STATE DOMINGUEZ HILLS AND NATURE PRESERVES IN URBAN CITIES

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Urbanization has removed much of southern California's natural habitat, fragmenting it into remnant patches or corridors. Despite loss of critical habitat, several wildlife species have been able to adapt to life in highly urbanized areas. Understanding what species of animals occur in an area is important for wildlife management and for comprehending the new and complex ecology urbanization has created. Wildlife tracks provide an affordable and convenient method of studying local fauna that are elusive and active during nocturnal hours. We utilized scent stations consisting of 1-m² quadrats filled with gypsum and baited with an animal lure. We identified and measured tracks of raccoon, coyote, brush rabbit and domestic cat. Scent stations were placed in open areas throughout the campus of California State University Dominguez Hills. In addition, scent stations were placed within the Dominguez Hills Nature Preserve and the nearby Gardena Willows Wetland Preserve. In particular, Coyote (*Canis latrans*) tracks were identified and plotted on a map with estimated home ranges. We hypothesized that coyotes would utilize the nature preserves and restored areas of the university campus. Our results suggest meso-predators such as raccoons, domestic cats, and coyotes, and smaller mammals such as brush rabbits, use both nature reserves and more developed settings such as our campus. We conclude that despite urbanization, natural areas and nature preserves may help support mesopredator populations.

Poster Session

INCREASING DISTRIBUTION OF NONNATIVE RED FOX (*VULPES VULPES*) HAPLOTYPES WITHIN THE RANGE OF THE NATIVE SACRAMENTO VALLEY RED FOX (*V. V. PATWIN*)

Sophie Preckler-quisquater; UC Davis - Mammalian Ecology and Conservation Unit; One Shields Ave, Davis, CA, 95616; (530) 754-7932; squisquater@ucdavis.edu; **Tom, J. Batter**; **Stacy, Anderson**; **Ben, N. Sacks**

The Sacramento Valley red fox (*Vulpes vulpes patwin*) is a unique subspecies endemic to the Sacramento Valley (SV) and is genetically distinct from the non-native red fox currently occupying contiguous parts of California's lowlands. Although non-native red foxes have occurred adjacent to the native range since the 1960s, hybridization between native and non-native red foxes was previously (2007-2009) discovered only within a restricted contact zone, while the core region of the SV range remained 100% native. This stability was interpreted to represent resistance to genetic introgression. More recently (2012-2015), we sampled a moderate number of sites within this core range to discover that ~35% contained non-native mitochondrial haplotypes. Although preliminary, this apparent rapid increase (0 to ~35%) in nonnative haplotype prevalence over the past several years represents a potentially serious threat and raises questions as to the mechanism behind this sudden shift. We hypothesize that the fitness of native foxes has declined more so than that of nonnative and hybrid foxes in response to the extreme drought of the past several years.

Poster Session

SALT MARSH HARVEST MICE (*REITHRODONTOMYS RAVIVENTRIS*) DISTRIBUTION, ABUNDANCE, AND POPULATION TRENDS IN THE EAST BAY REGIONAL PARK DISTRICT

David Riensche; East Bay Regional Park District; 2950 Peralta Oaks Ct, Oakland, CA, 94605; 510-544-2319; driensche@ebparks.org; **Brooke E. Wainwright**; **Erica M. Rutherford**; **Sarah C. Gidre**

The Salt Marsh Harvest Mouse (*Reithrodontomys raviventris*) is a state and federally listed endangered species endemic to the salt marshes of the San Francisco Bay Area. As a result of anthropogenic change, its pickleweed-dominated tidal marsh habitat has been greatly reduced. The East Bay Regional Park District manages 40 miles of shoreline, which includes viable Salt Marsh Harvest Mouse habitat. The District surveyed five sites for Salt Marsh Harvest Mice between 2012 and 2015. A total of 47 Salt Marsh Harvest Mice were captured, with a total population index of 1.36 (individuals/trap nights x 100). There was no significant correlation between captures and pickleweed height and coverage; however, populations differed significantly among sites and a simple linear regression analysis of captures by year showed a significant decline. Continued monitoring is necessary to determine what the potential drivers might be producing these observed trends.

Poster Session

GREAT GRAY OWL SURVEY EFFORT AND OCCURRENCE IN THE CENTRAL SIERRA NEVADA

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Great gray owls (*Strix nebulosa*) in the Sierra Nevada of California are known to occur in and near Yosemite National Park, often associated with montane meadows. However, there are sporadic sightings and occurrences throughout the Sierra Nevada located at a variety of elevations and within a variety of habitats. To better understand great gray owl distribution within the central Sierra Nevada and to verify absence or presence during timber harvest planning, 111 yearly survey efforts of 55 survey areas were conducted from 2006 to 2015. These survey areas occur at a variety of elevational ranges (646-2274m) and consist of a variety of habitats. Sixteen territories were located, all occurring below 1100 meters elevation (range: 649-1085m). Twenty-eight reproductive sites produced 56 fledged young and 8 nests were discovered. Sierra Pacific Industries' biologists continue to conduct surveys for great gray owls on company lands throughout the central Sierra Nevada, but high elevation habitats do not appear to support territorial great gray owls.

Poster Session

MODELING BLACK BEAR-VEHICLE COLLISION ZONES IN YOSEMITE NATIONAL PARK

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The purpose of this study was to identify road and habitat characteristics associated with black bear-vehicle collisions in Yosemite National Park and to suggest proper mitigations to reduce their occurrence. Black bear-vehicle collision data collected by Yosemite National Park staff between 1995 and 2011 were used to identify variables associated with collisions. Geographic Information System (GIS) mapping software was used to map and split Yosemite roads into 1 km segments. After measuring road and bear habitat-related variables along each road segment, logistic regression analyses showed that segments with collisions were associated with crossing sites, understory vegetation, curves, close proximity to meadows, and a flat outbound shoulder slope. GIS spatial pattern and hot spot analysis were then used to group segments by their relative frequency of collisions: zero, low, moderate, and high. Logistic regression analyses of those same road segments, now grouped by their collision frequency, showed that segments with high frequencies of collisions were associated with a lack of visibility, fewer crossing sites, high understory cover, steep shoulder slopes, and close proximity to human development and meadows. The findings of this study were used to suggest effective and appropriate mitigation strategies for reducing collisions between bears and vehicles.

Poster Session

LOW-IMPACT RESTORATION OF SAN DIEGO FAIRY SHRIMP VERNAL POOL HABITAT ON MARINE CORPS AIR STATION MIRAMAR

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Marine Corps Air Station (MCAS) Miramar supports the largest contiguous block of habitat and highest number of vernal pools occupied by the federally endangered San Diego fairy shrimp (*Branchinecta sandiegonensis*) within the range of the species - approximately 4,051 basins out of 7,531 total mapped basins on station (including pools, road ruts, ditches, and other seasonally ponded features) that support vernal pool plant and animal species. Cardno was contracted to recontour and restore a suite of vernal pools on MCAS Miramar occupied by San Diego fairy shrimp, as well as the federally endangered vernal pool plants, San Diego mesa mint (*Pogogyne abramsii*) and San Diego button celery (*Eryngium aristulatum* var. *parishii*). By applying low-impact techniques - manual salvaging of soil containing fairy shrimp cysts and vernal pool plant seeds; recontouring/restoring vernal pool basins using hand tools; surveying and mapping pre- and post-restoration basin topography; and replacing salvaged soil - we were able to fully recontour/restore vernal pools without the need for potentially impactful heavy machinery. We conclude that manual restoration of vernal pools is a low-impact, viable option for small-scale restoration projects.

Poster Session

THE ROLE OF FOSTERING IN SAN CLEMENTE LOGGERHEAD SHRIKE POPULATION MANAGEMENT

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San Clemente Loggerhead Shrikes (*Lanius ludovicianus mearnsi*) are endemic to San Clemente Island - an important training site for the U.S. Navy. These passerines are an endangered subspecies, having undergone a severe population decline in the 1970s resulting in listing under the Endangered Species Act. In response, the Navy initiated a multi-faceted recovery program, including a captive propagation facility on the island. For twenty-five years, the San Diego Zoo Institute for Conservation Research has managed this facility to: produce juveniles for release, maintain a population reserve in case of catastrophic loss in the wild, and provide care for abandoned wild eggs and chicks. This care consisted of artificial incubation and hand-rearing until lower survival was documented for hand-reared than

parent-reared juveniles after release to the wild. In 2009, new management protocols were developed to allow the fostering of salvaged wild eggs in captive nests. After two initial successes, these techniques were extended to include salvaged chicks and have replaced the previous hand-rearing techniques as management protocol for rescued clutches. Adaptively changing protocols to address the needs of the population allows the program to fulfill its mission and support the wild population of San Clemente Loggerhead Shrikes.

Poster Session

GPS-TRACKING REVEALS MOLT MIGRATION AND YEAR-ROUND MOVEMENTS OF A BLACK-HEADED GROSBK FROM YOSEMITE NATIONAL PARK

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Recent miniaturization of GPS devices enables studying passerine migration with unprecedented precision. Black-headed Grosbeak (*Pheucticus melanocephalus*) is a molt-migrating species documented to undergo its prebasic molt during fall in the North American Monsoon region of the southwestern United States and northwestern Mexico. During June 2014 we GPS-tagged nine adult Black-headed Grosbeaks in Yosemite National Park with Lotex Pinpoint-8 archival gps tags. In June 2015 one of these birds was recaptured with its GPS unit still attached. By August 20, 2014, the bird had traveled 1,300 km to Sonora, Mexico. It remained there until November, when it flew 1,324 km to the Michoacan-Jalisco border, where it remained until the last coordinates were collected on March 24, 2015. These data are consistent with the expected seasonal timing and duration of a molt-migrating bird, and represent the first time breeding, molting, and wintering sites have been identified with this level of precision in a western Neotropical migrant. Remote-sensed Enhanced Vegetation Index (EVI) data revealed that the grosbeak arrived in the monsoon region just after the EVI reached its peak, and then departed as the index declined, suggesting a possibly delicate match between migration timing and monsoon-driven phenology that warrants further study.

Poster Session

LEXICON OF LOVE: VOCALIZATIONS IN MULTIPLE POPULATIONS OF RANA BOYLI

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Vocal communication in frogs has many purposes including securing territory, warding off intruders or competitors, and finding mates. *Rana boylei*, the focus of this study, primarily call under water due to their small vocal sacs. Consequently, full characterization of their call spectrum has proven challenging. Little is known about the vocalizations of this species, apart from one preliminary study conducted in a single population. This previous study distinguished five distinct calls made by *R. boylei*, but did not characterize variation among populations. I examined variation in call types within and among populations of *R. boylei* during the mating season and compared them for differences across three geographically isolated populations. I recorded underwater vocalizations using a hydrophone and analyzed dominant frequency, duration, and note/pulse duration using the bioacoustics software Raven Pro. At least one previously undescribed call has been identified from one site, and characterization of differences among populations in predominant calls is ongoing. Knowledge of mating communication habits is essential to inform potential future translocation efforts for this rapidly declining frog.

Poster Session

Student Paper

PREDATION OF SALT MARSH HARVEST MICE IN THE SUISUN MARSH

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Common predators of the salt marsh harvest mouse (*Reithrodontomys raviventris*) have never been identified. During thousands of hours in the Suisun Marsh, during a three year field study we made opportunistic observations of both nocturnal and diurnal predators. Through visual sightings, auditory observations, as well as observations of sign, including scat and tracks, we identified likely common predators of the salt marsh harvest mouse. We also observed confirmed predation events by a northern harrier (*Circus cyaneus*), a white tailed kite (*Elanus leucurus*) and a yellow bellied racer (*Coluber constrictor*).

Poster Session

Student Paper

USING CAMERA TRAPS TO ESTIMATE WILDLIFE ABUNDANCE AND HUMAN RECREATIONAL USE IN THE LAGUNITAS CREEK WATERSHED

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Camera trapping is a useful tool for monitoring wildlife across landscapes. In areas that support both recreation and wildlife, it is important to be able to estimate the amount of human recreational use as well as wildlife abundance. Our two study areas covering 11.75 sq. km included comparable public lands in the Lagunitas Creek watershed of Marin County, California. These two study areas were monitored concurrently by a total of 47 camera traps set at 0.5 km intervals. We are interested in how recreational use may influence wildlife abundance and already suspected from some preliminary analyses that one study site had greater pedestrian use, and in this study we wanted to explore metrics for estimating human abundance. Typically detection rates (detections per 100 trap nights) are used in estimating abundance using camera traps. We used occupancy modeling for wildlife but human trail use violates an assumption under occupancy modeling. Nonetheless, we were curious to see how using occupancy performed when applied to human trail use in this case and compared to rates of detection. As we suspected, pedestrian detection rates were substantially greater at one of our study sites and greater than other types of human recreational use. However, human occupancy estimates were similar between both sites, which may indicate that the area (size) of use, rather than the intensity of use, was similar. This suggests that using rates of detection as the only metric for human use could be misleading. Interestingly, wildlife occupancy estimates were similar at both study areas indicating that the area in which pedestrians are active (extent) may be more important than the actual number of pedestrians present within a site. Further analysis using covariates such as distance from trails would help in continuing to explore whether human recreation influences wildlife abundance.

Poster Session

Student Paper

CALIFORNIA GRUNION IN THE PRESIDIO, SAN FRANCISCO - SPAWNING MONITORING IN SUMMER 2015

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Caltrans increased the drainage capacity and length of a stormwater outfall within the tidal area of Crissy Beach in the Presidio, San Francisco, California during the summer of 2015. As a provision of the National Parks Service special use permit, Crissy Beach was monitored for California grunion (*Leuresthes tenuis*). Grunion runs in Southern California are well documented but are considered rare in Northern California. Presence of grunion at Crissy Beach was undetermined prior to 2015 monitoring efforts, but suspected by the California Department of Fish and Wildlife. Monitoring at Crissy Beach was conducted by AECOM biologists at night, during peak high tides at full and new moons in June and July. Biological monitors recorded the number of individuals (10 - 1000), size, location, and timing of each spawning event. Grunion spawning was observed 13 out of 16 survey nights. The turbidity curtain deployed around the project footprint had an unintended secondary use as a grunion exclusion device. Biologists and construction personnel worked closely

to ensure the outfall was completed on schedule while ensuring grunion spawning areas were protected. This project presented a rare opportunity to document grunion spawning in the San Francisco Bay.

Poster Session

BIRTH SITE SELECTION BY MULE DEER

Danielle Walsh; University of Nevada, Reno; 1664 N. Virginia Street, Mail Stop 186, Reno, NV, 89557; 702-371-1653; walshd10@gmail.com; **Kelley M. Stewart**; **Bruce. K. Johnson**; **Michael J. Wisdom**

Population dynamics of ungulates are often influenced by survival of juveniles, which is typically low and variable. Mule deer neonates are the most susceptible to predation following parturition due to their limited mobility. Thus, parturient females should select birth sites which increase the likelihood of survival by neonates following birth. We measured a variety of habitat characteristics at birth sites and random sites to determine selection of birth sites by parturient females. We used resource selection functions in a use-availability design to examine selection of birth sites. We created models using a mixed effects logistic regression with the female as the random effect. We used Akaike's Information Criterion adjusted for small sample size (AICc) to evaluate model support. We model averaged the top models with delta AICc values under 2. Our best model showed significant selection of birth sites with increased canopy cover, woody debris, and placement on South facing slopes. South facing slopes are typically warmer and xeric affecting the plant species present. Woody debris increases hiding cover for neonates while canopy cover can influence microsite temperatures as well as provide pockets of light increasing camouflage of neonates.

Poster Session

Student Paper

TRACK TUBE MODIFICATION AND USE WITH THE SAN BERNARDINO KANGAROO RAT (*DIPODOMYS MERRIAMII PARVUS*)

Thea Wang; San Diego Zoo Institute for Conservation Research; 15600 San Pasqual Valley Rd, Escondido, CA, 92027; 3234720479; twang@sandiegozoo.org; **Debra, M, Shier**

The San Bernardino kangaroo rat (*Dipodomys merriami parvus*) was once common in the floodplains of San Bernardino, Menifee and San Jacinto Valleys. Currently, 96% of their previous habitat has been developed for agricultural and urban uses. At this time, San Bernardino kangaroo rats are only found in small areas of the San Jacinto River, Santa Ana River, and Cajon and Lytle Creeks. Detecting the presence and absence of this species is largely conducted with live trapping methods however the use of less invasive techniques may be beneficial. We modified the existing technique of PVC pipe track tubes which use non-toxic ink and paper to identify types of small mammals from their foot prints. We demonstrated the use of these track tubes by San Bernardino kangaroo rats and that the foot prints of these species can be distinguished from other species with in the same habitat. Previously track tubes have been used with quadrupedal species but our work shows that they are also appropriate for small bipedal species.

Poster Session

COMPARING THE COST-EFFECTIVENESS AND RELIABILITY OF SCAT DETECTION DOGS AND REMOTE CAMERAS FOR SAMPLING HUMBOLDT MARTENS

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Carnivores can be challenging to survey because of their low density, large home range size, and secretive behavior. The Humboldt subspecies of Pacific marten (*Martes caurina humboldtensis*) persists in small isolated populations in coastal California and Oregon. This Distinct Population Segment was petitioned for listing consideration under the Endangered Species Act, but denied in April 2015. The Humboldt marten subspecies is associated with dense berry-

producing shrubs, which may provide shelter from potential predators. Dense shrub cover also provides survey challenges as access is difficult. We examined the cost-effectiveness of two survey methods: scat detection dogs and remote cameras paired with hair snares. We used three metrics to compare these methods: number of detections, sex ratio, and the ability to obtain extractable genetic material. Costs were similar between methods. Preliminary results suggest that remote camera surveys provided opportunities over larger geographic extents, and detections were more consistent with scat detection dogs at a fine scale. We encourage future research to consider the sex and age of detected animals, focusing on conservation relevance to the population in addition to species occurrence.

Poster Session

ENDANGERED SPECIES MANAGEMENT AND CLIMATE CHANGE: WHEN HABITAT CONSERVATION BECOMES A MOVING TARGET

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As climate conditions worldwide continue to shift, species assemblages and ecological community composition may be reshuffled in unpredictable ways and "novel ecosystems" may emerge. Some habitat types may cease to exist while others may expand in size and protecting ecosystems and species in their current locations will become increasingly difficult. Threatened and endangered species within these areas are likely to be disproportionately affected by climate change, since they are often habitat specialists and relatively rare. The Endangered Species Act (ESA) has prevented the extinction of many plant and animal species, and the identification and conservation of critical habitat is an important tool for species preservation. But how do we designate and preserve critical habitat for protected species when we are unsure about future environmental conditions? Here we address this question utilizing a climate adaptation framework based upon the idea of managing for change, rather than focusing on the maintenance of existing conditions. We offer suggestions and guidelines related to the inclusion of climate considerations into endangered species habitat and management plans. Finally, we illustrate our conceptual ideas with a case study of an endangered mammal endemic to Southern California, Stephens' kangaroo rat (*Dipodomys stephensi*).

Poster Session

SPATIAL ECOLOGY OF WESTERN BURROWING OWLS IN SAN DIEGO COUNTY DURING THE BREEDING SEASON

Colleen Wisinski; San Diego Zoo Institute for Conservation Research; 15600 San Pasqual Valley Road, Escondido, CA, 92027; 760-747-8702x5727; cwisinski@sandiegozoo.org; **Lisa A. Nordstrom**; **Jeffrey L. Lincer**; **Kira L. Marshall**; **Ronald R. Swaisgood**

The western burrowing owl (*Athene cunicularia hypugaea*, BUOW), a California Species of Special Concern, is at risk of local extinction in San Diego County. Successful management of BUOW and their grassland habitat depends on a thorough understanding of their population dynamics and resource use. Since 2011, we have been conducting research focused on several aspects of BUOW breeding season ecology at both natural and artificial burrows. As part of this larger project, we deployed GPS dataloggers in 2014 and 2015 to record foraging locations of provisioning males during the nestling period. Over these two breeding seasons, we gathered data from 8 individuals, with one tracked in both years, and found that the average maximum distance traveled was under 1 km with 90% of the locations within 660 m of each respective breeding burrow. Our results illustrate the importance of the habitat immediately surrounding the breeding burrow both in terms of its foraging quality and potential hazards to the birds. Consequently, the siting of artificial burrows, habitat restoration, and other management activities should take into account the habitat, food availability, and risks of disturbance or other negative impacts to BUOW within this small spatial scale.

Poster Session

GREATER SAGE GROUSE CUMULATIVE EFFECTS ASSESSMENT: AN INNOVATIVE APPROACH FOR A LANDSCAPE-LEVEL SPECIES

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Cumulative effects assessment for Greater Sage-Grouse involved innovative approaches to assessment of a landscape-level species across multiple states. The cumulative effects area was defined as the management zone, one of six floristic provinces established by the Western Association of Fish and Wildlife Agencies (WAFWA) across GRSG range. The geographical and temporal scope of each analysis included the species' eastern (Great Plains) or western (Rocky Mountain) range, with time evaluation extending forward 40 years. The analysis examined the incremental impacts of the Bureau of Land Management and Forest Service actions in GRSG habitat, in combination with other past, present and reasonably foreseeable future actions on public and private lands. These included development of oil and gas, alternative energy and infrastructure, as well as risk of impacts for stochastic events such as wildfire. Indirect effects of public management on private lands providing GRSG habitat were also considered, along with the interaction among actions, whether additive, countervailing, or synergistic. A case study of Utah shows how the interaction of multiple stressors across GRSG populations could determine the effectiveness of management actions.

Poster Session

Spatial Analysis of Wildlife-Habitat Relationships

FINE-SCALE MOVEMENT DECISIONS IN RELATION TO HABITAT SUITABILITY: A CASE STUDY WITH TULE ELK IN THE CARRIZO PLAIN NATIONAL MONUMENT

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Movement is a fundamental process that shapes the distribution and abundance of wildlife. With the advent of GPS collars that can record animal locations at fine spatial and temporal scales, we have incredible power to understand how animals make decisions across these scales. Relying on GPS collar data from seven Tule elk (*Cervus elaphus nannodes*) in the Carrizo Plain National Monument, we used kernel density estimates and time-dependent local convex hulls (t-LoCoH) to examine 2nd and 3rd order habitat selection and movement at day, week, month, and seasonal scales at an individual- and herd-level. In this talk, we will present habitat suitability models developed from these approaches. Then, we will examine whether habitat suitability plays an important role in movement decisions, characterized by velocity, elongation, patch visitation rates and duration of visits. Finally, we will also explore when other factors (e.g. weather, topography, and life history events) are more important to understanding such decisions.

Spatial Analysis of Wildlife-Habitat Relationships

HABITAT SELECTION OF PILEATED WOODPECKERS (*DRYOCOPUS PILEATUS*) IN A MANAGED FOREST ON THE HOOPA VALLEY RESERVATION

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Pileated woodpeckers (*Dryocopus pileatus*) are associated with characteristics of older forest stages, such as larger diameter trees and the presence of snags used for roosting, nesting and foraging. However, pileated woodpeckers are also known to use managed forests. The Hoopa Valley Reservation (HVR) is approximately 37,000 ha of mostly forested area with an array of seral stages from old growth to recently cut stands. The Hoopa Tribe manages timber, and makes provisions for the persistence of woodpeckers. However, no formal study has assessed pileated woodpecker habitat on the HVR, and habitat has not been well described in this region. We caught and outfitted 11 pileated woodpeckers with 10g transmitter backpacks between April 2009 and May 2013. We examined habitat selection with Resource Utilization Functions, which give a weighted value of bird use for every GIS cell. We created a fixed kernel estimator and with the plug-in method as the smoothing parameter, and then applied multiple regression to fit a model to the habitat covariates. We found that birds selected late seral attributes within their home ranges. This study will help address the need to inform the Tribe's current practices with knowledge of habitat for pileated woodpeckers.

Spatial Analysis of Wildlife-Habitat Relationships

Student Paper

TALKING ABOUT THE BIRDS AND THE BEES: ABUNDANCE AND DIVERSITY OF BIRDS AND BUMBLE BEES IN BURNED AND UNBURNED RIPARIAN HABITATS IN THE NORTHERN SIERRA NEVADA

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We conducted non-lethal bumble bee surveys on 413 study plots in meadows and along streams inside and outside the footprint of the 2007 Moonlight fire on Plumas National Forest in 2015. We caught, identified and released 1,243 individual bumble bees of 13 species, including the Western Bumble Bee (*Bombus occidentalis*), which is increasingly considered a species of management concern in California. Significant declines in Western Bumble Bee from southern British Columbia to central California have been observed but little is known about its current distribution. We describe

habitat associations of the different bee species, including elevation range and affinity to particular floral resources, and compare bee survey results between burned and unburned plots along streams and in meadows. In general, we found more bees at higher elevations within our study area, more bees in unburned than moderate or high burn severity plots, and more bees in meadows than along streams. At 181 of the streamside plots, we also conducted point count surveys for birds. We assess how well abundance and diversity of riparian birds predicts the abundance and diversity of bumble bees and explore implications for multi-species conservation planning and identifying priority areas for riparian restoration efforts.

Spatial Analysis of Wildlife-Habitat Relationships

BUMBLE BEE USE OF MONTANE CHAPARRAL AND RIPARIAN VEGETATION AFTER WILDFIRE IN THE CENTRAL SIERRA NEVADA

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During spring and summer of 2015, we studied habitat usage by bumble bees (*Bombus* spp.) across two areas burned by wildfire on the Eldorado National Forest in 2004. We conducted 966 survey visits to 495 plots, during which we captured, identified, and released 676 individuals of 12 *Bombus* spp. We examined bumble bee use of floral resources, abundance, and diversity in upland post-fire chaparral, burned forest, and riparian zones. Six species were found across both fire areas. Each fire also supported an additional three species not found in the other, even though the two areas had similar habitats and elevation, and were separated by only 25 km. *Bombus* abundance and diversity were significantly greater in riparian areas than upland habitats. Within upland chaparral, *Bombus* preferentially foraged on bear clover (*Chamaebatia foliolosa*), and largely avoided mountain whitethorn (*Ceanothus cordulatus*) and deer brush (*Ceanothus integerrimus*). The differential use of chaparral shrub species for foraging by *Bombus* species has management implications for post-fire land management, particularly the timing and use of mechanical and chemical treatments to discourage or remove chaparral, and the selection of chaparral patches for retention or removal.

Spatial Analysis of Wildlife-Habitat Relationships

MAKING GRAZING WORK AS A CONSERVATION TOOL

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California annual grasslands are highly dominated by non-native species, and are among the most invaded terrestrial systems in the world. The unchecked growth of non-native grasses and weeds is a frequent cause of habitat degradation and loss of biodiversity. Livestock grazing is generally the only practicable means of managing non-native herbaceous biomass on large acreages. This presents challenges to agency staff wary of grazing or unfamiliar with its capabilities, limitations, and operational requirements. A successful planning process will bolster the compatibility of species' and ranchers' needs. An interdisciplinary, collaborative, performance-based approach is key. We have developed over 30 regulator-approved grazing management plans for California grasslands, addressing the habitat needs of California red-legged frogs, California tiger salamanders, San Joaquin kit foxes, Bay checkerspot butterflies, Ohlone tiger beetles, and other listed wildlife. Elements of such plans include: (1) translating habitat needs into performance standards; (2) designating special management areas for targeted grazing; (3) providing structural heterogeneity of habitat; and (4) maintaining flexibility and feasibility. Here we present examples from plans for several listed animals, and broadly applicable lessons learned.

Spatial Analysis of Wildlife-Habitat Relationships

The Effects of Drought and Water Management on Wildlife

GRANIVORE MOVEMENT IN RELATION TO THE CONSERVATION OF THE RARE, ENDEMIC PLANT LASSICS LUPINE (*LUPINUS CONSTANCEI*)

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Lassics lupine (*Lupinus constancei*) is a rare perennial forb endemic to a 1-km² serpentine community on Mount Lassic and Red Lassic in Northern California. Pre-dispersal granivory by small mammals such as deer mice (*Peromyscus spp.*) and chipmunks (*Tamias spp.*) has led to a recent population decline. Granivore exclusion increased population viability, yet this is not a practical long-term management solution. Encroachment of chaparral and forest communities may facilitate granivory on lupine. Quantifying movement of small mammals in and among the chaparral, forest, and serpentine communities given their potential effects on the Lassics lupine's reproductive success, may aid in effectively conserving this plant species. We marked animals using ear tags and PIT tags in Summer 2015. Using a capture/recapture approach, we modeled granivore movement within and among the different communities. Deer mice moved an average of 34.1 meters whereas chipmunks moved 39.5 meters between trapping occasions. Deer mice movements were mainly within serpentine or chaparral communities with ~17% among community types. Chipmunks stayed mostly within forest or chaparral communities and moved more often among community types (~37%). Examination of granivore movement into different community types may yield novel insight into habitat based, long-term management actions for rare, endemic plants.

The Effects of Drought and Water Management on Wildlife

Student Paper

GRASSHOPPER ABUNDANCE IN BLUNT-NOSED LEOPARD LIZARD HABITAT DURING A MAJOR DROUGHT

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Observed variation in numbers of blunt-nosed leopard lizard neonates in 2014 following a multi-year drought suggested that winter precipitation plays a role in lizard reproduction and recruitment. One potential causal link between precipitation and lizard recruitment is grasshopper abundance, which is expected to be higher when productivity is high. We gathered preliminary data to assess the abundance of grasshoppers over the leopard lizard breeding season at multiple sites occupied by leopard lizards. We found significant temporal variation over the course of the seven month breeding period at all sites, and a shared pattern of early season high abundance, a mid-summer drop in abundance, and a rise in abundance in the fall. The pattern tracks the observed activity pattern of leopard lizards, where individuals are highly active in spring and early summer, absent in mid-to late summer, and active again in the fall. We interpret our findings as providing support for the hypothesis that grasshopper abundance partially mediates seasonal lizard activity.

The Effects of Drought and Water Management on Wildlife

CHALLENGES ASSOCIATED WITH TRANSLOCATION OF A FEDERALLY THREATENED AMPHIBIAN DURING THE WORST DROUGHT IN A GENERATION

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California Red-legged Frog (*Rana draytonii*: CRLF) is a federally threatened species and a California Species of Special Concern. Historically, little has been done with amphibian translocations to unoccupied habitat as a recovery tool for listed species. WRA has implemented phased restoration of four of 12 ponds located at Ridge Top Ranch Conservation Bank, a 744-acre working cattle ranch. In consultation with USFWS, WRA translocated egg-masses to the restored ponds in 2012 and 2013, which coincided with the onset of a four year-long drought. Following a successful first year, the ongoing drought conditions have resulted in increasingly arid site conditions, adding an additional stressor to the

population. Since translocation, constant vigilance and monitoring have been required to ensure the CRLF populations persist through years of consecutive drought. Despite the challenges and with forecasts suggesting a wet-year ahead, there is every reason to be optimistic that CRLF will begin to proliferate at Ridge Top Ranch. If translocation can ultimately prove successful in the face of the worst drought conditions in a generation, this method of reintroduction may be proven as a viable tool to help recover the species.

The Effects of Drought and Water Management on Wildlife

QUANTIFYING CHANGE IN WETLAND EXTENT AND ITS EFFECT ON A WESTERN AND CLARK'S GREBE BREEDING POPULATION AT EAGLE LAKE, CA 1997-2010

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Western and Clark's grebes (*Aechmophorus occidentalis* and *A. clarkii*; respectively) are sympatric water birds that breed at inland lakes and reservoirs. Both species are wetland-obligate nesters that build floating nests constructed-of and anchored-to emergent vegetation. Despite grebe dependence on flooded wetland habitat for nesting, the relationships among lake level, wetland availability, and reproductive success have not been well quantified. We modeled thirteen years of reproductive data collected at Eagle Lake, California. This lake is a closed-drainage system, whose annual lake level varies drastically with annual rainfall and evaporation. We used remote sensing techniques to quantify changes in wetland availability relative to inter-annual lake level changes. An information-theoretic approach was used to assess the relationship among and importance of these habitat variables in relation to grebe reproductive success. Our results indicate that lake level is a key factor affecting wetland availability and population-level reproductive success. Our findings also indicate an optimum water level where management is likely to be most effective. We strongly recommend that wetland managers consider the effects of water level on breeding habitat availability and reproductive success of grebes and other over-water nesting birds.

The Effects of Drought and Water Management on Wildlife

Wildlife and Renewable Energy

A NEW APPROACH TO MANAGING DESERT TORTOISE DURING CONSTRUCTION AND OPERATION OF RENEWABLE ENERGY FACILITIES

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Topaz Solar Farm (TSF) and California Valley Solar Ranch (CVSR) were constructed on over 2000 hectares that support significant numbers of endangered, threatened, and special-status species within the Carrizo Plain, San Luis Obispo County, California. Species present include San Joaquin kit fox, American badger, giant kangaroo rat, San Joaquin antelope squirrel, and burrowing owl. Detailed species distributions were incorporated during project design to minimize impacts. For example, the initial CVSR layout would have impacted over 90% of giant kangaroo rats on site, yet construction impacted less than 10%. San Joaquin kit fox were observed within the CVSR construction footprint on over 1000 occasions and at TSF radio-collared kit foxes were located daily within the construction footprint. No construction related injury or mortality of kit foxes or giant kangaroo rats occurred at either site during the multi-year build out. Monitoring and avoidance techniques utilized during construction and operation of these facilities would be highly applicable to monitoring and avoiding desert tortoise at similar facilities in the Mojave Desert; negating or reducing the need for permanent removal of tortoises, while reducing mortality and loss of habitat. Here we present practical recommendations for managing tortoise populations within renewable energy facilities during and post-construction.

Wildlife and Renewable Energy

SAN JOAQUIN KIT FOX HABITAT UTILIZATION AT A LARGE-SCALE SOLAR FACILITY

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San Joaquin kit fox (SJKF) use of habitat on and around Topaz Solar Farms has been studied since 2008 over an approximately 10,000 acre study area. A combination of annual scat surveys and radio collars has allowed tracking of kit fox individuals, locations, and habitat use. We present data from the first full year of post-construction kit fox tracking and the first year of GPS collar data. Currently, kit foxes regularly utilize completed solar array fields, and additional individuals are present in the vicinity. SJKF continue to be tracked post-construction with scat studies for five years and with GPS telemetry on up to 20 individual kit foxes for three years. Information gathered will provide a measurement of SJKF use on and near this large PV solar facility, and could help inform management decisions on future large-scale energy projects.

Wildlife and Renewable Energy

BACKGROUND AND RESULTS OF THE LARGEST AND LONGEST AVIAN FATALITY MONITORING PROGRAM AT A WIND FARM IN HISTORY, THE ALTAMONT PASS

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A lawsuit over the high number of raptor fatalities in the Altamont Pass Wind Resource Area (APWRA) prompted Alameda County to institute the largest avian fatality monitoring program in the history of the wind industry. The monitoring program lasted over 9 years (ending September 2014), and was overseen by a scientific review committee with representatives appointed by the County, the Wind Energy Industry, and environmental groups. Previous estimates of fatalities in the APWRA were based on "average" detection probabilities that varied greatly from one analysis to the next, leading to controversy and confusion. Results of the recent effort were based on detection probabilities estimated

from several studies implemented by the monitoring team over several years. Lessons learned from this program with respect to sampling design, statistical rigor, the pitfalls of drawing premature conclusions and making predictions based on a limited data set, and how to set up and manage a scientifically credible, responsible, and effective scientific oversight process have wide-spread applicability. In the end, the monitoring program produced a new paradigm for estimating detection probability, implemented several important studies, and identified one major confounding factor precluding an accurate assessment of the effectiveness of management actions to reduce raptor fatalities.

Wildlife and Renewable Energy

EFFECTIVENESS OF CUT-IN SPEED ADJUSTMENTS ON REDUCING IMPACTS TO MEXICAN FREE-TAILED BATS AT A WIND ENERGY FACILITY IN NEVADA

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Direct impacts to bats at wind energy development projects are one of the biggest issues facing the wind industry; however, much of the research on reducing impacts to bats has largely focused on migratory tree-roosting bats (e.g., hoary bat [*Lasiurus cinereus*]) and listed species (e.g., Indiana bat [*Myotis sodalis*]) in the eastern US, where adjustments to turbine cut-in speeds have shown to be an effective tool for reducing impacts to these focal species. In general, direct impacts to bats have not been as great in the western US; therefore research on mitigation and minimization opportunities for bats have been rare in western parts of the country. The Mexican free-tailed bat (*Tadarida brasiliensis*) is among the most commonly found bat fatalities at some western wind energy facilities, whereas this species does not typically occur in the eastern US. In this presentation we present the results of studies investigating the effect of increasing turbine cut-in speeds on reducing bat fatalities, including Mexican free-tailed bats, at a wind energy facility in eastern Nevada. This facility is located near a migratory stopover site/cave used by large numbers of migrating Mexican free-tailed bats. Increasing cut-in speeds has reduced bat mortality rates at the project.

Wildlife and Renewable Energy

PREDATION ECOLOGY OF VERTEBRATES AT A CALIFORNIA WIND FARM

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The global benefits of renewable energy come at a local cost to ecosystems and communities. For example, wind energy developments have the potential to kill birds and bats and fragment habitat for local terrestrial vertebrates. If sensitive species are extirpated, patterns of biotic interactions may be altered at wind farms. In this study, I address the effects of wind farms on local wildlife by comparing abundance and richness of target species known to prey upon a ubiquitous lizard, *Uta stansburiana*, at similar sites with and without turbines in the San Geronio Pass in California. I quantify wariness, survival rates, and population sizes of *U. stansburiana* to identify whether changes in wind farm predator communities affect prey populations in ecologically important ways. Analyses indicated that wind farms were less diverse; turbine presence significantly explained observed predator assemblage patterns. For *U. stansburiana*, I found no difference in behavior or demographic parameters between site types, implying similar levels of apparent predation. My results suggest that small vertebrate prey may not be affected directly by habitat loss, nor by higher trophic level changes at wind energy developments. Some predators were less abundant at wind farms and further research is needed to better understand the factors driving these changes.

Wildlife and Renewable Energy

Student Paper

Wildlife Health and Disease Ecology

EXPOSURE OF TURKEY VULTURES TO PENTOBARBITAL IN MARIN COUNTY

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Between July 2014 and July 2015, seven turkey vultures, *Cathartes aura*, were found immobilized in Marin County due to pentobarbital exposure. Sodium pentobarbital is a barbiturate used for veterinary euthanasia. Pentobarbital intoxication has been documented in many scavenging species, most notably golden and bald eagles, presumably from consuming euthanized animals. While clinical data of pentobarbital toxicity to raptors is scarce, incidents of multiple raptors being poisoned from a single large carcass have been reported. In addition, pentobarbital is persistent in tissue and has been detected in carcasses for up to two years. Typically, intoxicated animals are found dead, comatose, or staggering within a short distance of the site of exposure. However, these turkey vultures were found throughout Marin County within 15 miles of each other, and no probable source(s) of exposure could be located. All vultures eventually recovered with supportive care and were released. Given the inability to determine the source(s) of the contaminated carcasses, outreach efforts were made to veterinarians and livestock groups regarding the proper disposal of euthanized carcasses.

Wildlife Health and Disease Ecology

SARCOPTIC MANGE IN URBAN SAN JOAQUIN KIT FOXES: STATUS, ASSESSMENT, AND INTERVENTION STRATEGIES

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Sarcoptic mange was confirmed in an urban population of San Joaquin kit foxes (*Vulpes macrotis mutica*) inhabiting Bakersfield, CA in March 2013. Since then, over 100 cases of kit fox mange have been detected and the disease has been fatal without intervention. At least 39 foxes are known to have died from mange and the number is likely much higher. With funding from the Morris Animal Foundation, we conducted camera surveys throughout Bakersfield to locate foxes with mange and identify epidemiological foci. During summer 2015, 105 camera stations were established in 1-km sq grid cells and operated for 7 nights. Kit foxes were detected in 69 (66%) cells and foxes with mange were detected in 9 (9%) cells. As with opportunistic detections, attempts were made to trap and treat affected animals. While survey results indicated that mange is now widespread in the Bakersfield population, we foxes in many parts of the city that are not yet infected. Future actions include continuing to trap and treat foxes as they are detected, testing the efficacy of protecting foxes with Seresto acaricidal collars, and exploring strategies for treating earthen dens where the majority of transmissions may be occurring.

Wildlife Health and Disease Ecology

POST-RELEASE MONITORING OF OILED AND REHABILITATED BROWN PELICANS (*PELECANUS OCCIDENTALIS*) AFFECTED BY THE 2015 REFUGIO OIL SPILL

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Despite the enormous amount of financial resources, personnel, and time devoted to oiled wildlife rehabilitation, there remains a paucity of information on post-release survival and behavior of most affected species. Brown pelicans (*Pelecanus occidentalis*) are near-shore seabirds that are frequently affected by oil spills. In a previously published study of brown pelicans that were oiled, rehabilitated, and released in California in 1990-91, oiled birds disappeared at a

higher rate than control birds, showed movement patterns typical of nonbreeding birds, and did not demonstrate any evidence of breeding activity. In May 2015, Plains Pipeline 901 spilled >100,000 gallons of oil near Refugio State Beach, California. Fifty oiled pelicans were captured and subjected to rehabilitation efforts. Forty-six survived and were released following rehabilitation using established protocols. Of these, 12 adults (6M, 6F) were fitted with solar-powered GPS satellite transmitters and released in June. In early July, we captured 8 adult (3M, 4F, 1U), unoiled pelicans near Ventura CA. These were similarly instrumented and released immediately. Four months after release, transmitters from 11 of 12 oiled and all 8 control pelicans were still transmitting. One oiled bird disappeared abruptly in mid-September; despite multiple searches, no carcass was found. Oiled pelicans traveled >5000 km, ranging from the central Oregon coast to the western Mexican coast of the Gulf of California. Although our sample size is limited, these data demonstrate that pelicans can survive oiling and rehabilitation, and that their movements are similar to those of controls for at least 4 months post-release.

Wildlife Health and Disease Ecology

INCREASING EVIDENCE FOR A NOVEL MARINE HARMFUL ALGAL BLOOM AND PUTATIVE ANTHROPOGENIC POLLUTANT: UPDATE ON CYANOTOXIN (MICROCYSTIN) TRANSFER FROM LAND TO SEA OTTERS

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Cyanobacteria, or "blue-green algae", thrive in warm, nutrient-enriched, anthropogenically degraded watersheds worldwide. Under optimal conditions, cyanobacteria can form super-blooms, releasing potent cyanotoxins into lakes, rivers and estuaries. Once formed, these toxins can concentrate in food webs and spread downstream, killing animals and posing human health risks. Over the past 30 years, an increased distribution, severity and duration of these blooms has been noted worldwide. One of the most common and concerning is the hepatotoxin microcystin. Until recently, microcystin was considered to be a problem solely of freshwater and estuarine systems, primarily affecting livestock and pets. However, numerous reports have documented marine outflow of microcystin from impaired watersheds. In 2007, deaths of Southern sea otters, a state and federally protected threatened marine mammal, were linked to microcystin intoxication, and microcystin was identified in nutrient-impaired watersheds flowing into the Monterey Bay National Marine Sanctuary. Spatial patterns are apparent between microcystin-positive sea otters and contaminated river outflows, and at present, no local marine source has been identified. Sea otter exposure may result from contact with microcystin-contaminated freshwater runoff, or consumption of marine filter-feeders. Because humans consume many of the same prey items, our preliminary findings raise concern regarding potential unrecognized human health risks.

Wildlife Health and Disease Ecology

ACUTE, SUB-LETHAL AND LONG-TERM EFFECTS OF EXPOSURE TO DOMOIC ACID IN CALIFORNIA SEA LIONS (*ZALOPHUS CALIFORNIANUS*)

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The current unprecedented algal blooms off the California coast emphasize that domoic acid toxicosis is an increasing problem for marine vertebrates. Domoic acid is an excitatory neurotoxin produced by marine algae, such as *Pseudo-nitzschia australis*. Acute domoic acid toxicosis resulting from the glutamate agonist action of domoic acid was first documented in California sea lions (*Zalophus californianus*) that stranded off California in 1998. Animals displayed neurologic signs, including ataxia, disorientation, seizures, and death. Pathologic findings in acutely affected animals consisted of acute, ischemic, neuronal necrosis in the pyramidal cells of the hippocampus and granular cells of the dentate gyrus, and acute myocardial necrosis. Since then, thousands of sea lions have stranded with signs of neurological disease at times when domoic acid producing plankton blooms were not always detected along the Pacific coast. Approximately 50% of these animals exhibit neurological effects longer than 2 weeks after initial stranding.

Additionally, approximately 10% of affected sea lions re-strand following release, compared with 0.5% that re-strand following treatment for other reasons. Magnetic resonance imaging on live animals and histopathology from animals that died or were euthanized revealed varying degrees of unilateral and bilateral hippocampal atrophy, neuronal necrosis and gliosis in the limbic system. While all age classes and sexes are affected, 79% of cases have been adult females. Reproductive failure as a result of abortion and premature parturition was observed in approximately 1/3 of affected adult females. Domoic acid has been detected in amniotic fluid, fetal urine and gastric fluid tested up to 2 weeks after stranding. This suggests the fetus acts as a sink for domoic acid that is typically rapidly cleared from mammalian species (half life in primates is 4 hours). These data suggest that exposure to domoic acid can have effects on sea lion reproduction and survival beyond acute mortality documented to date and that animals may be exhibiting signs of persistent, sub-lethal exposure to the toxin.

Wildlife Health and Disease Ecology

Wildlife Techniques and Technologies

THE RELIABILITY OF POPULATION VIABILITY ANALYSIS FOR SPECIES WITH DIFFERENT GENERATION TIMES

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Estimating and projecting population trends using population viability analysis (PVA) is crucial to identifying species at risk of extinction and for informing conservation management strategies. The reliability of PVA is highly susceptible to the underlying variability present in the system, the level of error in the data and the type of model used. Furthermore, since evidence indicates that generation time influences population dynamics by altering the variability present in the system, it is expected that PVAs perform differently across species with different life histories. In this study, we evaluated the reliability of predictions from PVA for hypothetical species with different generation times under different levels of environmental variability and uncertainty. PVA predictions were generated from simulated data using both matrix and scalar models and assessed with respect to Rule A.3 under the Red List of the IUCN. We found that the reliability of PVA predictions depended upon the interaction between generation time and growth rate. Specifically, both matrix and scalar models exhibited decent performance for "slow" life histories (long generation time and low growth rates), although matrix models exhibited a more precautionary tendency. In contrast, we found that for "fast" life histories with short generation times and high growth rates PVA predictions exhibited less reliability, especially under high process and measurement error. In conclusions, our results indicate that caution must be taken when interpreting the results of PVAs with short generation times and high intrinsic growth rates.

Wildlife Techniques and Technologies

EVALUATING THE USE OF UNMANNED AIRCRAFT SYSTEMS (UAS) FOR MONITORING COLONIAL NESTING WATERBIRDS

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Aerial imagery obtained from manned aircraft surveys is commonly used for monitoring colonial nesting waterbirds. Recent technological advances have spurred interest in the use of unmanned aircraft systems (UAS) for wildlife monitoring. UAS offer the ability to collect data at both high spatial and temporal resolutions while minimizing wildlife disturbance and observer safety risks. The potential advantages that UAS present depend on a number of factors including mission objectives, flight duration, sensor payload capacity, data processing workflows, and current regulatory requirements. In May 2015, we, in collaboration with the Pyramid Lake Paiute Tribe, set out to conduct UAS flights at Anaho Island National Wildlife Refuge in Nevada. We targeted American white pelicans (*Pelecanus erythrorhynchos*), double-crested cormorants (*Phalacrocorax auritus*), and California gulls (*Larus californicus*) to evaluate the utility of UAS for monitoring and informing the reproductive biology of colonial nesting waterbirds. By using fine-scale change detection with a multi-temporal nearest neighbor analysis, we were able to develop a rapid, accurate method to differentiate nesting from non-nesting individuals. Here, I will present the results of our work and discuss recommendations for planning and conducting colonial nesting waterbird surveys, and processing and evaluating the resulting imagery.

Wildlife Techniques and Technologies

Student Paper

RETAINED SATELLITE INFORMATION INFLUENCES PERFORMANCE OF MINIATURE GPS DEVICES (45-51G) IN A FORESTED ECOSYSTEM: A CASE STUDY WITH PACIFIC MARTEN

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GPS units used in animal telemetry suffer from non-random data loss and location error. GPS units use stored satellite information to estimate locations, including almanac and ephemeris data. Using the smallest GPS collars (45-51g) available for mammals, we evaluated how satellite information and environmental conditions affected GPS performance in 27 mobile trials and field reliability during 56 deployments on Pacific marten (*Martes caurina*). We programmed GPS units to retain or remove satellite data (i.e., continuous or cold start) before attempting a location (fix), thereby mimicking differing fix intervals. In continuous mode, fix success was 2.2 times higher, was not influenced by environmental obstructions, and improved after a location with satellites (3-D). In cold start mode, fix success was negatively correlated with vegetation cover. Location error was lower for 3-D fixes. Censoring cold start fixes with only 3 satellites (2-D) and 2-D locations prior to the first 3-D fix in continuous mode decreased location error by 91% and 55%, ensuring <50m accuracy. The significance of previous fix success and reduced battery expenditure underscores the benefits of ephemeris data and short fix intervals. Only 66% of 56 units functioned upon delivery for field deployment. Once tested and deployed, 28% malfunctioned. This study demonstrates that GPS tests should use the same schedules as field deployments, and GPS data quality in dense cover improves with short fix intervals. Lastly, with a short fix interval we reveal these devices can provide exceptional data for territorial carnivores. Miniature GPS units are a promising tool, but the study design should be carefully considered.

Wildlife Techniques and Technologies

GIS TECHNIQUES FOR ANALYZING AND MAPPING FIELD DATA

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Biologists are interested in analyzing and communicating field data using GIS generated maps. Typical field data consists of GPS point locations and habitat or vegetation maps derived from satellite imagery or interpreted directly from aerial photographs. These data can be presented as basic mapped data whereby each vegetation polygon can be coded with species presence, thereby creating a habitat map of polygons that represent average activity values. Additional mapping techniques include spatial coincidence mapping of two or more data layers and using interpolation methods to analyze geographic patterns of species distributions. A result of interpolation methods is a surface that better represents the discrete field data points as a more realistic surface of continuous data. Standardized map variables and normalizing maps by the standard normal variable (SNV) can highlight underlying areas that are one or more standard deviation below or above the average, thus showing locations of unusually high or low values instead of the typical averages within each vegetation polygon. Because maps are numbers, then they can be added, divided and subtracted (difference maps). Advanced analysis includes map calculus: spatial integrals and spatial derivatives. Incorporating geographic science into biological and GIS helps explain animal activity patterns in geographic space.

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