Conservation Biology Institute

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February 25, 2013

Subject: Comments on Draft Vegetation Treatment Program Environmental Impact Report (PEIR)

Dear Board of Forestry and Fire Protection:

The Conservation Biology Institute is a nonprofit research and planning institution that performs applied research and provides scientific guidance and review for conservation and land management plans. I am an ecologist and wildlife conservation biologist with over 30 years of ecological research experience in California and the west, including studies concerning the effects of fires and vegetation treatments on vegetation and wildlife, and on the habitat and population needs of numerous rare and endangered species. I also have extensive experience with CEQA and NEPA. I have attached my CV for reference.

Overview

The PEIR is fundamentally flawed in that it fails to support its conclusions in any meaningful way, and many of its conclusions are scientifically indefensible or simply wrong. *All of the findings in the PEIR (e.g., findings of significance/non-significance) are based on one foundational assumption that is demonstrably false or unsupported for most of the lands proposed for treatments*—specifically the assumption that vegetation treatments in wildland areas will reduce the size and severity of fires and thereby reduce risks to both human and natural communities. This assumption has been thoroughly debunked by the last 20 years or more of research on wildland fires and vegetation management in California (with the narrow exception that *strategic* treatments in *some* mixed coniferous or pine-dominated forests that evolved with frequent surface fires may be beneficial for restoring more natural fire regimes and reducing risks very large and severe fires). *In most California vegetation communities—especially chaparral, sage scrub, and grassland types and many non-pine forest types—the sorts of treatments proposed by the PEIR will not reduce fires risks, and are likely to do more harm than good relative to meeting the PEIR's stated goals.*

Problems with the PEIR

Most findings in the document depend on fundamental assertions that have been proven false by science—that the vegetation treatments outlined in the PEIR will effectively reduce the size and severity of wildfires in any and all regions and vegetation communities in California, and that treatments in wildland areas will reduce risks to homes or other human resources in developed areas. The PEIR ignores current scientific understanding of fire ecology in California's diverse natural communities, and uses a one-size-fits-all approach to fire management that is likely to do more harm than good when it comes to reducing fire risks to both human and natural communities. This flawed approach, which ignores the tremendous diversity of fire regimes and conditions across California—as well as a large literature presenting more effective and cost-effective solutions to reducing fire risks—is based on numerous poorly justified and outdated assumptions, an extremely vague description of the "Project" under CEQA, and simplistic, unjustified, unscientific analyses. The PEIR fails to meet CEQA requirements on a number of fundamental grounds:

Insufficient Program/Project Description. The description of the Project (or Program of projects) is so vague that the likely environmental impacts cannot be meaningfully analyzed. There is not even a map of the lands proposed for treatments. As a scientist, I cannot independently assess the likely impacts of the program based on the information provided, which is nothing more than unmapped guestimates of acreages that might be treated by different means in different regions, along with unsupported assumptions about how these actions might affect vegetation, wildlife, air, and other resources. The impact determinations that result from this approach are just simplistic speculations. In many cases, the PEIR's *opinions* about effects on resources are demonstrably wrong.

According to the PEIR, "a program-level EIR is prepared for an agency program or series of actions …considered under CEQA as one collectively large project with similar environmental effects." However, it is clear from any objective analysis that the proposed actions will certainly *not* have "similar environmental effects" throughout California's diverse ecoregions, which differ tremendously in fire terrain, fire weather, vegetation conditions, flora, fauna, species of concern, land management conditions, and numerous other factors. This diversity is in no way accounted for in the PEIR's simplistic assessment of environmental effects. Most notably, in relying on a few studies in dry coniferous forest types to represent all of California's bioregions, the PEIR completely ignores that most of the vegetation types proposed for treatments are natural crown-fire regimes (e.g., chaparral) in which fuels treatments are ineffective.

Grossly Oversimplified Purpose and Need. The description of the Purpose and Need for the Program—and indeed the entire approach used throughout the PEIR—is based on a biased, grossly oversimplified, unscientific, and provably incorrect theory that "fire exclusion" has universally increased fire risks across California and that we therefore need to "modify vegetation on wildlands to reduce the costs and losses associated with

wildfires and to enhance the condition of forests, rangelands, and watersheds." This simplistic, one-size-fits-all scenario has been disproved repeatedly by peer-reviewed fire science for many of the bioregions, vegetation communities, and resources at risk (e.g., Cary et al. 2009, Conard and Weise 1998, Keeley et al. 1999, 2009, Keeley and Zedler 2009, Owen-Price et al. 2012, Sugihara et al. 2006, Syphard et al. 2006, 2007, and other references too numerous to list). For example, the notions that (1) fire suppression has excluded fire from chaparral and sage scrub communities, leading to (2) an "unnatural" accumulation of fuels, and (3) that therefore treating these communities (with prescribed fire or other thinning/clearing treatments) will reduce fire risks, have all been thoroughly debunked by empirical science (Halsey 2008, Keeley et al. 1999, 2004, 2009, Conard and Weise 1998, Syphard et al. 2009, 2010, 2012, and many others). Most importantly, best available science is essentially unanimous that vegetation treatments *on wildlands* (i.e., more than about 100 feet from structures or other resources needing protection) will "reduce costs or losses associated with wildfires" or "enhance the condition" of ecological communities. This paradigm—which has scientific support in *some* coniferous forests that evolved with frequent, low-intensity, ground fires—simply does not apply in most bioregions and vegetation communities in California, where infrequent, severe, stand-replacing crown fires are the norm.

No Evidence the Proposed Treatments Will Be Effective. The PEIR provides no evidence, references, or research studies demonstrating the effectiveness of the proposed treatments in protecting homes or other structures. In fact, what little research is available to evaluate treatment effectiveness mostly concludes that the types of treatments proposed are *not effective* at protecting homes or other structures, unless strategically located immediately adjacent to the structures as defensible space for firefighters to use to advantage during a fire (e.g., Syphard et al. 2011a, 2011b, 2012). Treatments far from structures (e.g., more than about 100-120 feet away) do little good (e.g., Cohen 1999, 2000, Cohen and Stratton 2008).

Inadequate Alternatives. All alternatives presented in the PEIR are variations on the misguided assumption that clearing vegetation on wildlands will reduce fire risks to human or natural resources. The alternatives differ only in the different mixes of methods proposed to clear the vegetation (mechanical, herbicide, grazing, etc.). However, overwhelming scientific evidence shows that in almost all cases, vegetation treatments not directly in and immediately adjacent to the structures needing protection are not effective (Cohen 1999, 2000, Cohen and Stratton 2008).

An EIR must analyze a range of reasonable alternatives that could *feasibly attain the objectives of the project.* However, *none of the alternatives presented in the PEIR would achieve the stated objectives*. Reasonable alternatives that *would* meet the stated objectives would need to take a c*omprehensive approach to fire management that includes community and regional planning, reducing ignitability of structures, and using strategic fuel modifications within and directly around (e.g., within 100 feet of) the communities at risk.*

Substantial Factual Inaccuracies. The PEIR is so loaded with factual inaccuracies, outdated assumptions, distortions of science, and over simplifications that I cannot list them all here. Just a couple examples:

- The PEIR (Section 4.2) states that over-burned areas are rare in the South Coast Ecoregion and all are in coastal sage scrub. This is not true. Many chaparral areas have burned too frequently, relative to the natural range of variation, and are type-converting to weedy annual communities—and this trend is accelerating (Halsey 2011, Syphard et al. 2006, Keeley et al. 1999, 2011, Moritz et al. 2004). At the very least, the PEIR should consult Fire Return Interval Departure (FRID) maps (e.g., Safford and Schmidt 2008) rather than relying on nonscientific and incorrect opinions.
- Section 4.2.3 (and numerous other places in the PEIR) states that there are "excessive accumulations of flammable natural vegetation" in the WUI, without differentiating by bioregion or vegetation type. This statement is only true in limited portions of *some* forest communities, but is definitely not true in other areas, especially southern California shrublands. Much more problematic than natural vegetation is the accumulation of urban fuels (landscaping plants, wooden structures, etc.; Cohen 2000).

Attempts to Justify Statements with Inappropriate References and Failure to Cite More Appropriate and Contradictory References. CEQA guidelines require that an EIR should summarize points of disagreement among experts in a good faith effort at full disclosure. The PEIR fails to do this, instead citing mostly outdated, inappropriate, inaccurate sources with a clear bias towards justifying its predetermined approach to fire management and without citing numerous more recent, more scientifically valid, peer-reviewed studies that flatly contradict many PEIR assumptions and findings. This leads to numerous false statements and conclusions, including the foundational assumption that clearing wildland vegetation will reduce fire risks. Following are just a few *examples* of inappropriate uses of citations to support unsupportable conclusions:

- Section 4.2 has one of the most egregious examples of inappropriate citations to support biased assumptions. It cites a non-peer-reviewed report prepared by a San Diego County Wildland Task Force (2003) to support a proposal to conduct chaparral clearance projects in southern California. That Task Force report was actually withdrawn from the San Diego County website after an independent scientific review found that the report contained false and fabricated citations, misquoted research scientists, and presented a strongly biased and inaccurate assessment of fire science (San Diego Fire Recovery Network 2004). Scientists whose published research was cited in the Task Force report wrote the San Diego Board of Supervisors voicing their dismay with how their work had been distorted to support a biased and scientifically invalid approach to fire management (scientific review letters from C.J. Fotheringham, J. Keeley, F. Schoenberg, and R. Peng, 2004). *In some cases, the report said exactly the opposite of what the cited research found*. The independent science review of the Task Force report

concluded that it was "woefully inadequate and biased in its treatment of the available scientific information, and flawed in many of its assumptions, its treatment of published data, and its recommendations concerning vegetation management as part of a comprehensive fire-risk reduction strategy" (San Diego Fire Recovery Network 2004). Citing this unpublished and repudiated Task Force report in the PEIR undermines the PEIR's credibility.

- Section 4.2 cites Bonnicksen (2003) to support a statement about adverse effects of severe wildfires on streams and forests. Bonnicksen (2003) is not a peer-reviewed or scientific reference, but rather testimony to a committee of Congress by a highly controversial timber industry lobbyist with a record of misrepresenting science as well as his credentials to speak about science (Rundel et al. 2006). Four highly respected scientists (P. Rundel, M. Allen, N. Christinsen, and J. Keeley) wrote an open letter to the media to counter an op-ed offensive by Tom Bonnicksen, who was distorting science, along with his qualifications, to push a political agenda (Rundel et al. 2006). In their words:

  > Dr. Bonnicksen's unusual theories of forest structure and stability… were never widely accepted… there is no serious scientific support for Dr. Bonnicksen's ideas of forest management…. Dr. Bonnicksen's views and misrepresentations of factual material, as well as his academic credentials, should be labeled for the political views they are and not presented as serious science. The opinions he presents are contradicted by all prevailing scientific data (Rundel et al. 2006).

- Section 4.2 cites Kaufmann and Catamount [nd] and Parsons and DeBenedetti, (1979) to support a statement that natural forest conditions in California were once open and park-like, with continuous ground cover. The first reference is a non-scientific article dealing with dry ponderosa pine forests in the southwestern US, as opposed to the more mesic, dense, mixed-coniferous forests most common in California. The second citation did *not* conclude that forests in California were open and park-like with continuous ground cover, but rather that mixed-conifer forests of Sequoia and Kings Canyon National Parks would have had "a mosaic of open and closed canopy conditions, as well as heavy to minimal ground fuels."

- Section 4.2.3 cites Finney (2005) as documenting that "treatments… can systematically realize extended attack benefits outside their actual boundaries…" The cited document, which applied to Ponderosa pine forest in Arizona, says no such thing, and in fact documented that the fire studied by Finney (2005) burned through and well beyond all fuel treatments. There are more relevant studies, conducted in California, that have showed little or no tactical benefits of fuels treatments or fuel breaks in wildland areas, especially in shrublands or under the extreme fire weather conditions that result in the greatest acreages and structural losses (e.g., Halsey 2008, Keeley et al. 2004, 2009, Syphard et al. 2012).

- The PEIR repeatedly cites UC Davis (1996) as supporting that fires are becoming larger and more severe throughout California. That document is specific to the

Sierra Nevada Ecoregion, and is way out of date concerning *current* trends. Trends in fire regimes vary greatly by region, and there are numerous more recent scientific publications evaluating these using best available science, which has advanced tremendously since 1996.

- In apparent attempt to justify treatments (e.g., canopy thinning) in marten (*Martes americana* [now *M. caurina]*) habitats, the PEIR states: "Reduction in canopy cover (short of complete removal) seems to have relatively little effect on mesocarnivores (K. Slauson, pers. comm.)." To the contrary, martens are sensitive to reductions in canopy cover and avoid openings. This biased assessment of the effects of thinning on martens is troubling, given the personal communication attribution to Keith Slauson, who strongly disagrees with the statement. In his words (K. Slauson, personal communication via email on January 28, 2013): "As you may have guessed this quote is taken completely out of context and I do not support it as the blanket statement it appears to be. I am not sure where this quote was taken, but it clearly was used in place of the numerous citations stating the opposite."

I could list many more inappropriate, outdated, or biased citations used by the PEIR to support non-scientific statements, but this should suffice.

Insufficient and Faulty Assessment of Cumulative Impacts. The PEIR fails to adequately assess cumulative impacts of the proposed treatments or the combination of treatments and wildfires on resources. Simply reporting average size of individual treatments or annual treatment acreage is not sufficient. The cumulative impact analysis must estimate acreages effected cumulatively over time, including how repeated treatments, in concert with wildfires and other disturbances, are likely to impact various resources, such as by type-converting natural habitats into weedy fields that do not support native plant and wildlife species.

Lack of Analytical Rigor and Findings of Significance. The PEIR appears to rely on a yet-to-be-produced "environmental checklist" for ensuring that environmental impacts will be avoided, minimized or mitigated and ensure that they are not significant. How can one evaluate whether impacts will actually be avoided, minimized, and mitigated when the checklist is not available? What little "analysis" is included in the PEIR lacks any transparency or analytical rigor. The findings use some vague estimates of acreages that may be impacted in different bioregions, some extremely broad descriptions of potential issues, and then some arm waving about how the impacts are likely to be less than significant. This "trust us" approach is a fatal flaw underlying all findings concerning environmental impacts in the PEIR.

Extremely Cursory, Out-of-Date, and Inaccurate Assessment of Wildlife Status and Impacts. Section 4.5.2 of the PEIR provides a biased, shallow, and outdated treatment of the status of wildlife resources in California, and Section 5.2.2 likewise provides a biased, shallow, and inaccurate assessment of likely impacts of the proposed treatment program on wildlife resources. Following are just a *few example*s from the sections

concerning "mesocarnivores" (martens and fishers), because I am considered an expert on these species*:*

- The PEIR cites Lyon et al. (1994) for current status of martens and fishers and makes the point that we know little about these species, despite the fact that there numerous more recent and applicable references that provide an especially rich understanding of the current status of habitat, populations, trends, and effects of fires and fuels treatments on these species, especially the fisher (e.g., Zielinski et al. 2013, Spencer et al. 2011, Scheller et al. 2011, and numerous others).
- The PEIR states: "In 2010 DFG announced that the Fisher (sic) was not a candidate for designation as threatened/endangered species." However, the PEIR fails to mention that fishers on the west coast, from California to British Columbia, are currently Candidates for federal listing under the ESA, with a final decision by the U.S. Fish and Wildlife Service needing to be made (under a court order) by 2014. Given that the isolated population of fishers in the Sierra Nevada is estimated at fewer than 300 adults and is experiencing elevated mortality rates due to human influences (Spencer et al. 2011) listing potential is high.
- It states: "The population status of the Humboldt marten (*Martes americana humboldtensis*) in northwestern California is uncertain (Lyon et al. 1994)." Actually, intensive and extensive surveys have been performed for the Humboldt marten in the nearly 20 years since this 1994 citation. Slauson et al. (2009) estimated the population based on occupancy surveys and concluded that the Humboldt marten population likely contains less than 100 individuals and is most likely declining. Listing potential is very high.
- The PEIR states: "Optimal habitats for marten are various … including…Jeffrey pine, and eastside pine." This is an inaccurate description of marten habitat. These forest types are generally too open and xeric to support breeding populations of marten.
- It states "Martens utilize small clearings…for foraging." This is misleading unless "small" is better defined. Martens avoid nearly all openings, rarely venturing more than a few meters away from overhead tree cover. This statement could be used to justify that fuel breaks or "small" clear cuts benefit marten, which is not true. Even ski runs in marten habitat are avoided (K Slauson pers. comm.).

Likewise, the evaluation of likely effects of the PEIR treatments on the Threatened California gnatcatcher is misleading:

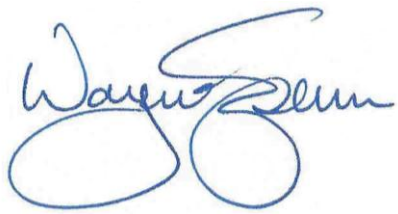
- The PEIR states that the gnatcatcher avoids "dense, overgrown shrublands and so may benefit from treatments that create a better-proportioned mosaic of shrub mixed with open areas." It never defines the subjective phrases "dense, overgrown" or "better-proportioned" in speculating about how treatments might benefit gnatcatcher habitat, and it fails to acknowledge that the gnatcatcher's native habitat is *already severely disturbed* by overly frequent fires, fire breaks,

human trampling, and other factors that have opened sage scrub up more than is normal or natural. Sage scrub in the South Coast Ecoregion is already type-converting to weedy conditions that cannot support gnatcatchers, and additional treatments would likely worsen this impact. Moreover, Atwood et al. (2002) demonstrated that most gnatcatcher pairs live in sage scrub stands greater than 20 years old, and that population persistence through bad winters is highest in the oldest stands.

Conclusions

This PEIR is fundamentally flawed, should not be certified, and needs to be completely redone using a much more scientifically valid approach to wildfire management. My comments represent only a partial sampling of the problems inherent in the proposed approach to reducing fire risks. I recommend that the program be rethought with input from experts in fire research, wildlife, and other appropriate topic areas.

Sincerely,



Dr. Wayne D. Spencer
Director of Conservation Assessment and Planning

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Dr. Spencer is a wildlife conservation biologist with over 30 years of professional experience in biological research and conservation planning. He specializes in the practical application of ecological and conservation science to resources management, design of nature reserves, and recovery of endangered species. He has conducted numerous field studies on rare and sensitive mammals, with particular focus on forest carnivores (e.g., martens and fishers) and endangered rodents (e.g., Pacific pocket mouse and Stephens' kangaroo rat). He is currently serving as Principle Investigator for California's Mammal Species of Special Concern project. Dr. Spencer also collaborates with other researchers and planners to develop and apply methods for identifying and conserving wildlife movement corridors and maintaining ecological connectivity in the face of climate change and habitat loss and fragmentation. He has provided scientific guidance for several large-scale habitat connectivity plans, including the South Coast Missing Linkages Project and the California Essential Habitat Connectivity Project. In the past, Dr. Spencer has prepared habitat conservation plans (HCPs), habitat management plans (HMPs), and natural community conservation plans (NCCPs) for numerous sensitive species in California, including the first NCCP plan ever permitted (Poway Subarea NCCP/HCP). Because he has both research and real-world conservation planning experience, Dr. Spencer is often asked to lead science advisory processes to provide guidance for regional conservation and recovery plans, such as the California Desert Renewable Energy Conservation Plan and the Sacramento-San Joaquin Bay Delta Conservation Plan.

EDUCATION

Ph.D., Ecology and Evolutionary Biology, University of Arizona. 1992. Highest Honors.

M.S., Forestry and Resource Management/Wildlife Ecology. University of California, Berkeley. 1981. Honors.

B.S., Biology and Wildlife Management (double major). University of Wisconsin, Stevens Point. 1978. Highest Honors.

RECENT AWARDS

2011 Special Recognition Award, Desert Tortoise Council
2011 Special Contributions Award, Desert Tortoise Preserve Committee
2008 Conservationist of the Year Award, Western Section of The Wildlife Society

SELECT PROJECT EXPERIENCE

Science Facilitator and Lead Advisor for Regional Conservation Plans — Numerous Agencies. Served (or serving) as science facilitator and lead science advisor for a wide variety of large-scale HCPs and NCCPs throughout California, including the Desert Renewable Energy Conservation Plan, the Sacramento-San Joaquin Bay Delta Conservation Plan, the Altamont Pass Wind Resource Area Conservation Plan, and NCCP/HCP plans for the counties of Butte, Santa Clara, San Diego, Merced, Yuba, Sutter, and Yolo, and the city of Santa Cruz. These plans cover hundreds of listed and sensitive species in diverse habitats and ecological communities, usually under severe pressures from urban development, agricultural expansion, energy development, increasing water use, or other threats to biological integrity. The process includes selecting and leading groups of independent science advisors to reach consensus on scientific principles and solutions, reviewing extensive technical information, organizing questions and issues for advisors to address, compiling and editing inputs from the advisors, and usually serving as first author and editor of the resultant science advisory reports. The advisory reports serve as foundations for planning large ecological reserve systems and developing adaptive management and monitoring plans to sustain biological diversity, native habitats, and the species inhabiting them.

Principle Investigator for California Mammal Species of Special Concern – California Department of Fish and Game. Leading a Technical Advisory Committee and other contributors in a comprehensive update of the Mammal Species of Special Concern (MSSC) in California. The team has developed and is applying a systematic scoring procedure to rank mammal species, subspecies, or distinct population segments for their relative degree of conservation concern within California. They are compiling all available locality data and other pertinent information concerning the status and distribution of nominee taxa, and preparing species accounts for the final list of MSSC. The results will be used to update Department of Fish and Game's official list of sensitive taxa and will be published in book and web formats.

Principle Investigator for California Essential Habitat Connectivity Project California Department of Transportation, California Department of Fish and Game, and Federal Highways Administration. This project was a highly collaborative effort to identify and characterize areas important to maintaining a functional network of connected wildlands throughout the state of California. The project produced three primary products: (1) a statewide Essential Habitat Connectivity Map, (2) a database characterizing areas delineated on the map, and (3) guidance for mitigating the fragmenting effects of roads and for developing and implementing local and regional connectivity plans. The essential connectivity network consists of 850 relatively intact and well-conserved natural landscape blocks larger than 2,000 acres and 192 essential connectivity areas for maintaining wildlife movement and other ecological flows among them. The final report provides detailed guidance for considering ecological connectivity in transportation and land management planning, preparing finer-resolution regional and local connectivity plans and linkage designs, and siting and creating road-crossing improvements for wildlife to improve ecological connectivity and reduce vehicle-wildlife

collisions. All products were produced using cutting-edge GIS modeling methods in a highly collaborative, transparent, and repeatable process that could be emulated by other states. The project received the 2011 Exemplary Ecosystem Initiative Award from the Federal Highways Administration.

Lead Scientist for Pacific Fisher Baseline Assessment and Cumulative Effects Analysis in the Sierra Nevada, California – US Forest Service, Region 5. Led a comprehensive compilation and analysis of data on the Pacific fisher (*Martes pennanti*)—which was found to be "warranted but precluded" for endangered species listing in 2004—to assess the species' historic, current, and future habitat and population status in the Sierra Nevada, and especially to assess the cumulative effects of wildfires, fuels management, timber harvest, and other threats to this isolated population. The project included extensive coordination with state, federal, and local agencies and stakeholder groups (e.g., conservation organizations and timber industry representatives), and facilitation of an independent science advisory body to ensure application of best available science. Cutting-edge spatial-analytical tools were used to forecast changes in fisher habitat and population size under various forest management and fire scenarios, and to forecast resulting effects on population viability. This involved coupling landscape-level models of fire and vegetation dynamics with fisher habitat suitability models and spatially explicit population dynamic models using GIS.

Project Manager/Lead Biologist for Habitat Conservation Plans and Natural Community Conservation Plans – Numerous Agencies. Managed the design, analysis documentation, public involvement, and permitting processes for a variety of regional HCP/NCCPs in California pursuant to the Endangered Species Act and the California NCCP Act, including the following:

- *Poway Subarea HCP/NCCP – City of Poway, California.* The first plan successfully permitted under the NCCP Act of 1991, this wildlife conservation plan was designed to sustain populations of 42 sensitive species in an interconnected habitat network within a 25,000 acre planning area.
- *Multiple Habitat Conservation Program (MHCP) – San Diego Association of Governments (SANDAG).* Managed design and documentation of this HCP/NCCP covering 7 incorporated cities and over 186 square miles in north San Diego County. Oversaw development and use of a comprehensive GIS database to design a biologically defensible plan that balances conservation and economic concerns. Included a public policy development and coordination component to ensure consensus between all pertinent organizations and agencies, as well as economic and financing analyses for plan implementation.
- *City of Carlsbad Habitat Management Plan (HMP).* Helped the City of Carlsbad complete a citywide HMP that also serves as a multiple species HCP/NCCP. Met with affected property owners and agencies to negotiate preserve areas within the 25,000-acre planning area; managed biological surveys, GIS analyses, and document preparation. The plan covered nearly 100 sensitive plant and animal

species, while preserving reasonable economic growth and private property rights throughout the city.

- *City of Oceanside HCP/NCCP.* Managed preparation of the City's subarea HCP/NCCP, which covered 27,000-acres. Tasks included managing field surveys, GIS database development and analyses, public outreach, and plan documentation.

Framework Monitoring Plan for the Channel Island Fox – US Navy and The Nature Conservancy. Served as project manager, science facilitator, and lead author on a project to review existing monitoring data and methods across all populations of the endangered Channel Island fox (*Urocyon littoralis*) and develop statistically robust monitoring methods to address population status, trends, and threats. Working closely with a panel of experts on fox biology, wildlife monitoring, and statistics, the team developed a statistically robust approach to monitoring population status and threats to the San Clemente Island fox (*U. l. clemente*) that met diverse operational and biological goals of the US Navy, which owns and operates San Clemente Island as a live-fire and special-operations training area. Based on this model, we developed a framework monitoring plan that could also be used on the other 5 islands supporting island fox populations (each island supports a unique subspecies and has different ownerships, management issues, and environmental conditions).

Research on Effects of Fire Severity and Distance from Unburned Edge on Mammalian Community Post-fire Recovery — U.S. Forest Service, Joint Fire Science Program, Riverside Fire Lab. Serving as Principle Investigator for a 4-year study of how mammal species and communities are recovering following the largest wildfire in California in over 100 years (the October 2003 Cedar Fire in San Diego County). Overseeing a crew of field biologists from the San Diego Natural History Museum sampling mammal communities and populations at numerous plots inside and outside the fire perimeter, at varying distances from the edge and in areas of differing fire intensity.

Pacific Pocket Mouse Studies Program – Transportation Corridor Agencies, U.S. Fish and Wildlife Service, and California Department of Fish and Game. Served as Principal Investigator for studies designed to further recovery of the critically endangered Pacific pocket mouse (*Perognathus longimembris pacificus*). Tasks included studying dispersal characteristics and other pertinent biological information on the species; performing detailed field studies of a surrogate subspecies to perfect field methods and design monitoring programs; determining the feasibility of a translocation or reintroduction program for the species, determining baseline measures of genetic diversity within and between extant (using live-captured specimens) and historic (using museum specimens) populations and developing genetic goals for the recovery program; and coordinating ongoing monitoring studies at extant population sites to maximize the value of the monitoring data for both scientific and preserve management goals.

Stephens' Kangaroo Rat Studies at the Ramona Airport, San Diego County, California – KEA Environmental. Verified a new population of the endangered

Stephens' kangaroo rat in the Santa Maria Valley, Ramona California, by trapping and reconnaissance surveys. Mapped the density and extent of this new, southern-most population, and performed GIS habitat modeling to predict other potential habitat throughout the Santa Maria Valley. Prepared a biological technical report and sections of the Biological Assessment for the Ramona Airport expansion project. Participated in a Section 7 consultation and prepared a Habitat Management Plan for the Stephens' kangaroo rat on the airport property. Prepared and oversaw implementation of a translocation program to salvage kangaroo rats prior to construction, house them in captivity, release them to release sites in improved habitat areas, and monitor success of the translocated population and the overall population in the area for several years.

Basewide Survey for Pacific Pocket Mouse – U.S. Marine Corps Base Camp Pendleton. Managed an intensive field survey to determine the distribution of the endangered Pacific pocket mouse on base. Developed detailed survey protocols in consultation with other mammalogists and the USFWS. Coordinated a team of 15 biologists performing reconnaissance and trapping surveys over all previously unsurveyed habitat for the species on base (over 6,000 acres). Managed development of a GIS database that summarizes all data for the species on base, including results of previous surveys. Analyzed habitat relationships of PPM using GIS and statistical models.

Studies on the Community Ecology of the Chihuahuan Desert – National Science Foundation. Studied the community ecology of desert rodents with Dr. James H. Brown, University of Arizona. Captured, identified, measured, and marked individuals of 15 species of rodents, including three species of kangaroo rats and three species of pocket mice, in over 20,000 trapnights in the Chihuahuan and Sonoran deserts. Trapped, marked, measured, and radio-tracked various species of kangaroo rats with Dr. Peter Waser, Purdue University, for a study of kangaroo rat behavior and ecology. Studied effects of foraging by javelina on native plant species. Performed microhabitat analyses and censuses and intensive foraging studies on wintering sparrow flocks while studying ecological interactions between desert rodents, birds, and ants in the Chihuahuan Desert (Thompson et al. 1991).

Pine Marten Ecology Studies in the Pacific States – U.S. Forest Service. Studied the ecology and behavior of pine martens in the Sierra Nevada and Cascade mountain ranges using trapping, radio-tracking, snow-tracking, smoked track-plate plots, and intensive habitat analyses (Spencer 1981; Spencer 1982; Spencer et al. 1983; Spencer and Zielinski 1983; Zielinski et al. 1983; Spencer 1987).

Studies of Space-use Patterns, Behavior, and Brain Evolution in Heteromyid Rodents – National Science Foundation and National Institute of Health. Researched space use patterns, memory, navigation, and spatial cognition in various species of kangaroo rats, pocket mice, and grasshopper mice (Spencer 1992). Collaborated with Dr. Lucia Jacobs on the evolution of spatial cognition and the hippocampus of the brain in kangaroo rats and pocket mice (Jacobs and Spencer 1991, 1994).

Mount Baker Geothermal Energy Development Biological Resources Assessment – Seattle City Light and Power Company. Led a team that studied the impacts of geothermal energy development on sensitive wildlife in old-growth forests on Mount Baker, Washington. Radio-tracked pine martens and performed trapping and other surveys for various rare carnivore species, including lynx, fisher, and wolverine. Coordinated with biologists studying northern spotted owls and mountain goats.

Assessment of Impacts of Free-roaming House Cats on Native Wildlife Populations at Saguaro National Monument and Tucson Mountain Parks – National Park Service, Western Region. Performed a study involving the impacts of free-roaming house cats on wildlife populations for the design of buffers around nature preserves in Arizona. Radio-tracked 14 free-roaming house cats and analyzed their movements, food habits, home ranges, and behaviors.

Miscellaneous Endangered Species Surveys — numerous clients throughout California, Arizona, and New Mexico. Coordinated and performed field surveys for the California gnatcatcher, coastal cactus wren, least Bell's vireo, southwestern willow flycatcher, desert tortoise, San Joaquin kit fox, and other rare and endangered species throughout the southwestern U.S. Coordinated and performed trapping surveys for the endangered Stephens' kangaroo rat, Pacific pocket mouse, Mojave River vole, and other rare small mammals in southern California.

Kern River Pipeline Desert Tortoise Surveys and Construction Monitoring – Kern River Company. Managed large crews of biologists doing field surveys and construction monitoring for the federally threatened desert tortoise throughout California, Nevada, Utah, and Arizona. Trained field biologists in techniques for surveying and monitoring tortoise populations. Educated construction personnel about mitigation requirements for protecting tortoises during construction of a natural gas pipeline across Utah, Nevada, and California. Relocated tortoises from the impact area under a memorandum of understanding with the USFWS.

PROFESSIONAL REGISTRATIONS AND PERMITS

Society for Conservation Biology
Association for Fire Ecology
American Institute of Biological Sciences
The Wildlife Society
American Society of Mammalogists
Society of American Naturalists
Sigma Xi Honor Society

TECHNICAL REVIEWER FOR:

Biological Conservation
Journal of Mammalogy
Journal of Wildlife Management
Landscape Ecology

Ecology
Canadian Field-Naturalist
Animal Behavior
Great Basin Naturalist
Transactions, Western Section of the Wildlife Society
National Geographic Society--Research Grants
US Fish and Wildlife Service—Miscellaneous listing and recovery proposals and plans

PUBLICATIONS

Spencer, W.D. 2012. Home ranges and the value of spatial information. Journal of Mammalogy 93:929-947.

Scheller, R.M., W.D. Spencer, H. Rustigian-Romsos, A.D. Syphard, B.C. Ward, and J.R. Strittholt. 2011. Using stochastic simulation to evaluate competing risks of wildfires and fuels management on an isolated forest carnivore. Landscape Ecology 26:1491-1504.

Beier, P., W. Spencer, R. Baldwin, and B. McRae. 2011. Toward best practices for developing regional connectivity maps. Conservation Biology 25:879-892.

Diffendorfer, J., G.M. Fleming, S. Tremor, W. Spencer, and J.L. Beyers. 2012. The role of fire severity, distance from fire perimeter and vegetation on post-fire recovery of small-mammal communities in chaparral. International Journal of Wildland Fire. http://dx.doi.org/10.1071/WF10060.

Carroll, C., W. Spencer, and J. Lewis. 2012. Use of habitat and viability models in *Martes* conservation and restoration. Pages 429-450 In: K. Aubry, W. Zielinski, M. Raphael, G. Proulx, and S. Buskirk, eds. Biology and Conservation of Martens, Sables, and Fishers: A New Synthesis. Cornell University Press.

Syphard, A.D., R.M. Scheller, B.C. Ward, W.D. Spencer, and J.R. Strittholt. 2011. Simulating landscape-scale effects of fuels treatments in the Sierra Nevada, California, USA. International Journal of Wildland Fire 20:364-383.

Spencer, W., H. Rustigian-Romsos, J. Strittholt, R. Scheller, W. Zielinski, and R. Truex. 2011. Using occupancy and population models to assess habitat conservation opportunities for an isolated carnivore population. Biological Conservation 144:788-803. DOI 10.1016/j.biocon.2010.10.027.

Spencer, W.D., P. Beier, K. Penrod, K. Winters, C. Paulman, H. Rustigian-Romsos, J. Strittholt, M. Parisi, and A. Pettler. 2010. California Essential Habitat Connectivity Project: A Strategy for Conserving a Connected California. Prepared for California Department of Transportation, California Department of Fish and Game, and Federal Highways Administration. February 2010.

Spencer, W.D., H.L. Rustigian, R.M. Scheller, A. Syphard, J. Strittholt, and B. Ward. 2008. Baseline evaluation of fisher habitat and population status, and effects of fires and fuels management on fishers in the southern Sierra Nevada. Unpublished report prepared for USDA Forest Service, Pacific Southwest Region. June 2008. 133 pp + appendices.

Beier, P., D.R. Majka, and W.D. Spencer. 2008. Forks in the road: Choices in GIS procedures for designing wildland linkages. Conservation Biology 22:836-851.

Beier, P., K. Penrod, C. Luke, W. Spencer, and C. Cabanero. 2006. South Coast Missing Linkages: restoring connectivity to wildlands in the largest metropolitan area in the United States. Pages 555-586 in: K. Crooks and M. Sanjayan, eds. Connectivity Conservation. Cambridge University Press.

Penrod, K., C.R. Cabanero, P. Beier, C. Luke, W. Spencer, E. Rubin, and C. Paulman. 2008. A linkage design for the Joshua Tree-Twentynone Palms connection. South Coast Wildlands, Fair Oaks, CA. www.scwildlands.org.

Penrod, K., C. Cabañero, P. Beier, C. Luke, W. Spencer, E. Rubin, R. Sauvajot, S. Riley, and D. Kamradt. 2006. South Coast Missing Linkages Project: A Linkage Design for the Santa Monica-Sierra Madre Connection. South Coast Wildlands, Idyllwild, CA. www.scwildlands.org.

Penrod, K., C. Cabañero, P. Beier, C. Luke, W. Spencer, and E. Rubin. 2006. South Coast Missing Linkages Project: A Linkage Design for the San Bernardino-San Jacinto Connection. South Coast Wildlands, Idyllwild, CA. www.scwildlands.org.

Penrod, K., C. Cabañero, P. Beier, C. Luke, W. Spencer, and E. Rubin. 2006. South Coast Missing Linkages Project: A Linkage Design for the Palomar-San Jacinto/Santa Rosa Connection. South Coast Wildlands, Idyllwild, CA. www.scwildlands.org.

Penrod, K., C. Cabañero, P. Beier, C. Luke, W. Spencer, and E. Rubin. 2006. South Coast Missing Linkages Project: A Linkage Design for the Peninsular-Borrego Connection. South Coast Wildlands, Idyllwild, CA. www.scwildlands.org.

Spencer, W.D. 2005. Recovery research for the endangered Pacific pocket mouse: An overview of collaborative studies. In B.E. Kus and J.L. Beyers, technical coordinators. Planning for Biodiversity: Bringing Research and Management Together: Proceedings of a Symposium for the South Coast Ecoregion. Gen. Tech. Rep. PSW-GTR-195. Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture, Albany, CA: 274pp.

Penrod, K., C. Cabañero, P. Beier, C. Luke, W. Spencer, and E. Rubin. 2005. South Coast Missing Linkages Project: A Linkage Design for the San Bernardino-Granite Connection. South Coast Wildlands, Idyllwild, CA. www.scwildlands.org.

Penrod, K., C. Cabañero, P. Beier, C. Luke, W. Spencer, and E. Rubin. 2005. South Coast Missing Linkages Project: A Linkage Design for the San Bernardino-Little San Bernardino Connection. South Coast Wildlands, Idyllwild, CA. www.scwildlands.org.

Penrod, K., C. Cabañero, P. Beier, C. Luke, W. Spencer, and E. Rubin. 2005. South Coast Missing Linkages Project: A Linkage Design for the Sierra Madre-Castaic Connection. South Coast Wildlands, Idyllwild, CA. www.scwildlands.org.

Penrod, K., C. Cabañero, P. Beier, C. Luke, W. Spencer, E. Rubin, S. Loe, and K. Meyer. 2004. South Coast Missing Linkages Project: A Linkage Design for the San Gabriel-San Bernardino Connection. South Coast Wildlands, Idyllwild, CA. www.scwildlands.org.

Penrod, K., C. Cabañero, P. Beier, C. Luke, W. Spencer, and E. Rubin. 2004. South Coast Missing Linkages Project: A Linkage Design for the San Gabriel-Castaic Connection. South Coast Wildlands, Idyllwild, CA. www.scwildlands.org.

Luke, C., K. Penrod, C.R. Cabanero, P. Beier, and W. Spencer. 2004. A Linkage Design for the Santa Ana – Palomar Mountain Connection: one of the South Coast's 15 Missing Linkages. Unpublished report. San Diego State University Field Station Programs, San Diego, California. www.fs.sdsu.edu

Penrod, K., C. Cabanero, C. Luke, P. Beier, W. Spencer, and E. Rubin. 2003. South Coast Missing Linkages Project: A Linkage Design for the Tehachapi Connection. South Coast Wildlands Project, Idyllwild, CA. www.scwildlands.org.

Swei, A., P.V. Brylski, W.D. Spencer, S.C. Dodd, and J.L. Patton. 2003. Hierarchical genetic structure in fragmented populations of the little pocket mouse (*Perognathus longimembris*). Conservation Genetics 4:501-514.

Spencer, W.D., M.D. White, and J.A. Stallcup. 2001. On the global and regional ecological significance of southern Orange County: conservation priorities for a biodiversity hotspot. Unpublished peer-reviewed report. Prepared for Endangered Habitats League. 44pp.

Jacobs, L.F., and W.D. Spencer. 1994. Space-use patterns and the evolution of hippocampal size in rodents. *Brain, Behavior, and Evolution* 44:125-132.

Spencer, W.D. 1992. Space in the lives of vertebrates: On the ecology and psychology of space use. Ph.D. dissertation. University of Arizona. 131pp.

Thompson, D.D., J.H. Brown, and W.D. Spencer. 1991. Indirect facilitation of granivorous birds by desert rodents: Experimental evidence from foraging patterns. *Ecology* 72:852-863.

Jacobs, L.F., and W.D. Spencer. 1991. Patterns of natural spatial behavior predict hippocampal size in kangaroo rats. *Soc. Neurosci. Abstr.*

Spencer, W.D. 1987. Seasonal rest-site preferences of pine martens in the northern Sierra Nevada. *J. Wildl. Manage.* 51:616-621.

Spencer, W.D., and R.H. Barrett. 1985. An evaluation of the harmonic mean measure for defining carnivore activity areas. *Acta Zool. Fennica* 171:255-259.

Spencer, W.D., R.H. Barrett, and W.J. Zielinski. 1983. Marten habitat preferences in the northern Sierra Nevada. *J. Wildl. Manage.* 47:1181-1186.

Spencer, W.D., and W.J. Zielinski. 1983. Predatory behavior of pine martens. *J. Mammal.* 64:715-717.

Zielinski, W.J., W.D. Spencer, and R.H. Barrett. 1983. Relationship between food habits and activity patterns of pine martens. *J. Mammal.* 64:387-396.

Spencer, W.D. 1982. A test of a pine marten habitat suitability index model for the northern Sierra Nevada. *U.S. Dep. Agric. For. Serv. Supp. Rep.* RO-33. 43pp.

Spencer, W.D. 1981. Pine marten habitat preferences at Sagehen Creek, California. M.S. Thesis, Univ. California, Berkeley. 121pp.

Spencer, W.D. 1978. Habitat changes on easement properties in the Lower Wisconsin River Wildlife Area. *Interdep. Rep., Wisconsin Dep. Nat. Resource.* 76pp.

SELECT PRESENTATIONS

California's Desert Renewable Energy Conservation Plan: A case study in use of independent science advice. Invited Keynote Address at annual conference of Northern California Conservation Planning Partners: Habitat Conservation Planning from Tahoe to the Bay. November 2012.

Planning for ecological connectivity from statewide to local scales. Invited Presentation, Caltrans Biologist Connectivity Training Workshop, Los Angeles, California. October 2011.

Potential effects of large-scale algal biofuels production on wildlife. Invited Presentation to National Academy of Sciences Committee on Sustainable Biofuels Production. August 2011.

Independent science advice for the California Desert Renewable Energy Conservation Plan: Background, Recommendations, and Future Directions. Invited Keynote Address at annual conference of the Desert Tortoise Council, Las Vegas, Nevada. February 2011.

Trends in independent science advice for NCCP/HCPs. Invited presentation at annual conference of the Western Section of The Wildlife Society, Riverside, California. February 2011.

Why mammals use home ranges: The value of spatial information. Invited Special Symposium Presentation, American Society of Mammalogists, Fairbanks, Alaska. June 2009.

Roles for science-based NGOs in wildlife management and conservation. Invited Plenary Talk at annual conference of the Western Section of The Wildlife Society, Redding, California. February 2008.

Managing landscape linkages to conserve desert wildlife during climate change. Invited presentation and panel discussion. The Climate & Deserts Workshop: Adaptive Management of Desert Ecosystems in a Changing Climate. Laughlin, NV, April 2008.

Improving science delivery for regional conservation plans: Lessons from science advisory processes in California. Invited presentation. Society for Conservation Biology, San Jose California, June 2006.

The science advisory process for regional NCCPs and HCPs. Invited presentation, Continuing Legal Education (CLE) workshop on regional conservation planning. San Francisco, California. December 2005.

Bioethical meanderings of a fur trapper to game biologist to ivory tower ecologist to bioslut to NGO conservation scientist convert. Invited talk at Special Session on Ethics in Wildlife Biology, Western Section of The Wildlife Society, February 2003.

Salvage translocation of endangered Stephens' kangaroo rats in a small, satellite population. Society for Conservation Biology, Duluth, Minnesota. 2003.

The role of consultants in conservation science delivery. Invited presentation at Regional Conservation Planning (NCCP/HCP) Workshop. Western Section of the Wildlife Society. Sacramento, California. 2001.

The science component of regional conservation plans. Invited presentation at Regional Conservation Planning (NCCP/HCP) Workshop. Western Section of the Wildlife Society. Sacramento, California. 2001.

Designing a translocation program to recover the critically endangered Pacific pocket mouse (*Perognathus longimembris pacificus*). American Society of Mammalogists. Missoula, Montana. 2001.

Status of mammals in near coastal habitats, with emphasis on the endangered Pacific pocket mouse. Invited Symposium Presentation. Planning for Biodiversity: Bringing Research and Management Together. Pamona, California. 2000.

U.S.-Mexican cooperation in the conservation of rare mammals: Workshop Introduction. International Theriological Congress IV. Acapulco, Mexico. 1997.

Does the extremely endangered pacific little pocket mouse exist in Baja, California, Mexico? International Theriological Congress IV. Acapulco, Mexico. 1997.

Linkage planning under severe constraints: gnatcatchers and the Oceanside stepping-stone hypothesis. Interface Between Ecology and Land Development in California. J.E. Keeley, ed. Southern Calif. Acad. Sci., Los Angeles. 1997.

Threatened and endangered species of California: a regional overview. CLE International Conference on the Endangered Species Act. San Diego, California. 1995.

Impacts of free-ranging house cats on wildlife at a suburban-desert interface. Society for Conservation Biology. Guadalajara, Mexico. 1994.

Resource dispersion, information, and space-use patterns of vertebrates. Animal Behavior Society. Binghamton, New York. 1990.

Statistical moments for analyses of two-dimensional distributions in ecology. Southwest Association of Biologists. Portal, Arizona. 1988.

Spatial learning and models of foraging movements. Southwestern Association of Biologists. Flagstaff, Arizona. 1987.

Multiple central-place foraging in small carnivores. American Society of Mammalogists. Albuquerque, New Mexico. 1987.

On cognitive maps and the optimal use of home range. Animal Behavior Society. Tucson, Arizona. 1986.

An evaluation of the harmonic mean measure for defining carnivore activity areas. Invited Paper: International Theriological Congress. Helsinki, Finland. 1982.

Selection of resting and foraging sites by *Martes americana*. International Theriological Congress. Helsinki, Finland. 1982.

Rest-site selection by pine martens at Sagehen Creek, California. Western Section of The Wildlife Society. Reno, Nevada. 1981.