

Californians for Renewable Energy, Inc. (CARE)

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Comments on the Preliminary Staff Assessment of the Metcalf Energy Center

K. Shawn Smallwood, Ph.D.

I have reviewed the CEC Preliminary Staff Assessment (PSA) of the Application for Certification 99-AFC-3, Metcalf Energy Center. I applaud Linda Spiegel for what appears to be a commendable effort to deal comprehensively with many of the issues related to biological resources. Many of her conclusions and recommendations appear sound, or at least provide an excellent start for further investigation and analysis. There are some issues that remain for me, however, and I would like to address these issues herein and in the Public Workshop on Biological Resources to be held in San Jose on June 22, 2000. In addition, my work on this project is only in its preliminary phase. I am sure there will be a significant number of additional issues that will need to be addressed, or addressed differently.

My qualifications for responding to the PSA are summarized in my short biography and Curriculum Vitae, which are attached.

Environmental Setting

The reconnaissance-level biological surveys at the proposed project site by CH2MHILL and CEC biologists appear to be fairly thorough. However, there are significant shortfalls. Some of them are the absence of bat surveys, small mammal trapping, and use of camera traps. I saw no evidence of netting or acoustical sampling for bats. Since multiple bat species are considered Species of Special Concern by our state and federal governments, I regard this shortfall as significant. I also saw no attempt to sample the small mammal species using traps, which severely constrains an understanding of which species are present. I recommend that proper sampling be implemented for bats and small mammals.

I want to point out a couple of findings I made at the site during my visits of 11 April and 2 May, 2000. My findings are significant because, as is typical with CEQA or CEQA-equivalent document preparation and assessment, the biologists of the lead agency are expected to limit their examination of any changes in existing physical conditions in the affected area since they occurred at the time of the notice of preparation (NOP). However, this baseline may not be the appropriate one from a scientific, biological standpoint, nor from the standpoint of maximizing environmental protection while avoiding or minimizing environmental harm, which constitutes CEQA's foremost principle. Biologists are familiar with natural changes in physical conditions and with periodic changes in site occupancy by species (Taylor and Taylor 1979). That is, if a species appears absent from a site at the time of the NOP, it could easily have been there prior to the NOP and it could very well be there again in the near future so long as the site supports suitable habitat. I want to present certain of my findings that demonstrate the need for prudent caution in determining which species exist at Tulare Hill, Fisher Creek and the adjacent upland area (proposed MEC site).

For example, I found an arboreal salamander on the west side of Fisher Creek downhill from the large spring on Tulare Hill (Photo 1), a western skink on the east side of Fisher Creek, a deer mouse on Tulare Hill, western fence lizards, pocket gophers, Tree Swallows, and Western Kingbirds. These species apparently were not found by CH2MHILL (2000: Table B-1, page 9-3). These species have no special status under California and federal laws and policies, but my finding them after other biologists visited the site on numerous occasions demonstrates the frustrating reality that animal species are always missed during site visits, no matter how exhausting.

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As another example, the PSA concludes that California Horned Lizards are unlikely to occur on Tulare Hill or the proposed project site, because the habitat is unsuitable. However, I found numerous harvester ant colonies on Tulare Hill (Photo 2), and harvester ants are the major prey of California Horned Lizards. I recommend that the likelihood of California Horned Lizard presence be reconsidered, and I recommend that some assessment be made of the possible impacts of NO_x deposition on harvester ants. The California Horned Lizard is a California Species of Special Concern. To meet CEQA's foremost principle, this type of enhanced examination is absolutely essential.

Also, I acquired photographs taken by one of the former land holders during 1992. These photographs of Tulare Hill and the upland area next to Fisher Creek show that this site was not as degraded as it is today (Photos 3-10). The junk piles were not there as they are today, and the vegetation was more lush on both Tulare Hill and the upland area next to Fisher Creek. These photographs were taken approximately the same time of year as my site visits, so the vegetation conditions should have been comparable with respect to phenology. The reduced plant height and density on Tulare Hill might indicate an impact from atmospheric pollutants since 1992, or part of a cyclic change in vegetation conditions with local climate variables. Whatever the reason for the apparent change in vegetation conditions, the biological species we see there today might not compose the same assemblage of species that was there in 1992, and it might not be the same assemblage that will be there in 10 years from now.

CH2MHILL prepared a summary of their biological surveys, entitled "Biological assessment for the Metcalf Energy Center Project, Santa Clara County, California." Overall, this document was well prepared and served as useful source material for Linda Spiegel's PSA. However, I found some problems with the CH2MHILL document. For example, California ground squirrels are reported to occur primarily on the western bank of Fisher Creek (page 1-12), and to not occur on the center portion of the site (page 2-11). This is not the case. Contrary to the claim made on page 2-11, construction of the MEC will not avoid potential aestivation habitat for California tiger salamander. California ground squirrels occupy the entire upland area where the applicant proposes to build Metcalf Energy Center, and these squirrels are abundant to the top of Tulare Hill. The widespread distribution of California ground squirrels is significant because their burrows serve as habitat for California tiger salamanders and red-legged frogs. In Table 1 (page 2-4), the potential impacts to these two species are downplayed because the impacts avoid aquatic habitat. Both the California ground squirrel and the red-legged frog *require* animal burrows, principally ground squirrel burrows, in upland areas away from the aquatic environment of streams such as Fisher Creek. Contrary to the claim made on page 2-11, construction of the MEC will not avoid potential aestivation habitat for California tiger salamander.

The likelihood of red-legged frogs occurring in Fisher Creek is downplayed on page 2-11 because bullfrogs occur there. Bullfrogs do not necessarily exclude red-legged frogs, even though they prey on tadpoles of red-legged frogs. The minimization of the potential significance of impacts on irreplaceable biological resources, whether intentional, accidental, or due to institutional bias, violates the spirit as well as the letter of CEQA's foremost principle. To comply with CEQA, this minimization must be avoided.

I disagree with the conclusion on page 4-4 that because the effluent stacks of the MEC would be below the elevation of Tulare Hill, and because transmission lines already exist in the area, migrating birds would be unlikely to collide with these stacks. This is a perfect example of the tendency to minimize the potential significance of the project's impacts. It is also an example of going out of one's way to come up with creative ideas to minimize that significance, which is directly opposite to the foremost principle of the CEQA statutory scheme. Under CEQA, it is far more appropriate to creatively ideate in the areas of thoroughness in assessing potential impacts and coming up with effective measures capable of avoiding or mitigating those impacts. For example, during my visit of May 2, 2000, I found an injured Common Raven at the base of one of the transmission towers on Tulare Hill (Photo 11). I draw

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the reasonable inference that this raven was injured by colliding with the tower or the wires. Just because this raven was removed from the candidate pool of birds that can collide with the MEC's stacks does not preclude other individuals or other avian species from doing so. Manville (2000) and Hoving and Sealy (1987) report disturbing fatality rates due to avian collisions with tall, lit towers. I recommend that CH2MHILL not downplay the significant threat posed by MEC's stacks to nocturnally migrating birds. I also recommend that the collision hazard be reduced to the extent possible and that it be factored into the formulation of mitigation.

Direct Impacts

At this early stage, I generally agree with Linda Spiegel's assessment of direct impacts, but I would add impacts that include the following. The power plant, laydown area, and access roads will destroy the ground squirrel burrows there. CH2MHILL (2000) is incorrect to conclude that this area is so disturbed by dogs that California ground squirrels do not occur in abundance there. Again, this is another example of taking the wrong perspective aimed at trivializing the severity of impacts, rather than maximizing environmental protection, as CEQA requires. California ground squirrels occupy the extent of the upland area at this location. If California tiger salamanders or red-legged frogs aestivate in those burrows, then they will be destroyed as well, and their habitat will be taken.

Indirect Impacts

At this early stage, I generally agree with Linda Spiegel's assessment, although I suspect, among other things, that noise and light levels will be more disruptive to wildlife than has been expected by the CH2MHILL and CEC biologists. Artificial light levels can interfere with dispersal movements of mammalian carnivores (Beier 1995), the mating-related singing behaviors of birds (Derrickson 1988, Bergen and Abs 1997), the behavior of nocturnal frogs (Buchanan 1993), the nocturnal emergence and foraging activity of salmonids (Contor and Griffith 1995), the activities and predation risk of moths (Frank 1988, Rydell and Baagoe 1996), the congregatory behavior and distribution of certain species such as American Crows (Gorenzel and Salmon 1995), the orientation and mobility of nocturnal, non-volant insects such as ants (Klotz and Reid 1993) and crawlers (Summers 1997), and all of these documented effects are relevant to the environmental conditions at the proposed MEC site. Far more work is needed before CEQA's stringent standards are met.

Cumulative Impacts

I agree with Linda Spiegel's conclusion that the NOx emissions from the proposed Metcalf Energy Center would create cumulative impacts to an already stressed ecosystem. The fact that the South Bay Area already exceeds federal air quality standards forces the conclusion that any additional emissions of these pollutants would exacerbate an already intolerable situation. Therefore, under CEQA not only must these potential impacts be deemed significant, but they must be carefully analyzed with regard to mitigation. I agree with Spiegel's recommendation that the applicant produce a cumulative impacts assessment. The cumulative impacts assessment performed by CH2MHILL (2000: page 7-1) is entirely inadequate. An adequate cumulative impacts assessment is absolutely essential, and failing to perform one would, in my opinion, violate CEQA. I also recommend that the applicant perform this assessment according to the standards described by McCold and Holman (1995). The preferred approach under CEQ is an identifiable, quantitative as well as qualitative, or performance-level assessment of a particular, potential environmental effect, which I think would be appropriate for assessments of cumulative impacts, and direct and indirect effects. Such performance levels of environmental effect also need to be built into adaptive management and monitoring (discussed below).

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The estimated contours of NO_x deposition illustrate the areas of vulnerability of soil-vegetation complexes, as well as their associated faunal assemblages. However, it would be more helpful if the applicant would overlay these contours with a map depicting the various levels of sensitivity of soil-grassland complexes to pollutants. Such an overlay can be used to forecast spatially-explicit impacts, much like Zhang et al. (1998) provided for excess nitrogen concentrations in ground water. Zhang et al. (1998) compared the spatial distribution of nitrogen inputs for agricultural crops to the spatial distribution of soil leaching potential. The inputs increasing the vulnerability of groundwater to nitrogen contamination and the inherent attributes of the soils made them more or less sensitive to such inputs. Zhang et al. (1998) forecast impacts that closely matched the measured impacts (i.e., nitrogen concentration in ground water sampled from wellheads). CH2MHILL should have the spatial data, software, and expertise to make such overlays and forecasts of impacts. CEQA requires nothing less. I recommend that this type of impact analysis be performed for NO_x deposition.

Mitigation

CEQA requires the mitigation measure to be *roughly proportional* to the project's impacts. Typically, proportional mitigation is estimated as a ratio of the area to be taken to the area to be conserved. The area of the MEC, laydown area, and access roads is easy to calculate and it is easy to match with a conservation easement or fee title purchase of similar habitat conditions elsewhere. Not so easy to calculate is the roughly proportional mitigation for the impacts of pollutants from stack emissions. Which of the estimated contours of NO_x deposition should the CEC use to determine the roughly proportional area that needs to be conserved as mitigation? I recommend that, given the uncertainty of impacts, the entire area projected to receive NO_x deposition should be considered when determining a roughly proportional mitigation. From the standpoint of maximizing environmental protection, and avoiding and minimizing environmental harm, this is the safest approach and thus the one that CEQA requires.

One of the mitigation options proposed by the applicant is to invest in a regional Habitat Conservation Plan (HCP). In so doing, the applicant defers the formulation of this portion of the mitigation to a later date when an HCP might be prepared. Under CEQA, the EIR should justify the choice of a particular mitigation measure, and with few exceptions it is improper to defer formulation of the mitigation to a later date. The mitigation measures need to be described explicitly and thoroughly in the EIR, along with the alternatives that were not chosen and an explanation as to why they were not chosen. The same should be done in the applicant's planning documents, in this case.

Additionally, HCPs are mitigation plans that facilitate the takings of endangered species more quickly and over larger areas than otherwise would be possible (Shilling 1997, Smallwood 2000, Smallwood et al. 1999). The applicant essentially would be investing in a vehicle to foster more land conversions to houses and commercial uses. An HCP would enable project proponents to destroy an even greater area of habitat than otherwise would occur. These land conversions would increase demand for electrical energy, and might possibly benefit Calpine-Bechtel. Therefore, I view this proposed mitigation as self-serving on the part of the applicant, but detrimental to the conservation of endangered and other species in the San Jose area. This is simply not allowed under CEQA, and the failure to correct this glaring deficiency will surely expose the environmental documentation to a successful legal challenge based on the EIR's inadequacy.

Adaptive Management

The applicant proposes to implement adaptive management based on habitat responses to cattle grazing on Tulare Hill. I encourage the CEC staff to demand more details of explicitly what this adaptive

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management would entail. Based on my professional experience, many project proponents have been proposing adaptive management strategies, without a proper understanding of what an adaptive management strategy entails. Adaptive management has been addressed in over 80 scientific publications, including several key papers and books (Holling 1978, Walters 1986, Lancia et al. 1996, McLain and Lee 1996). This literature describes a well thought-out step-by-step approach to learning about a managed environment while also provisioning the manager(s) with options to adopt alternative management practices. Management prescriptions, hypothesized environmental effects, and alternative management prescriptions are all specified prior to implementation. Many project proponents appear to think of adaptive management as a remedial, trial-and-error approach to problem-solving (see also CH2MHILL 2000: page 5-8). I encourage the CEC staff to determine whether the applicant really understands adaptive management. To be certain that the applicant does understand it, it should be described in detail in the application documents, along with the details of an integrated monitoring program.

Monitoring

Spiegel recommended that Calpine-Bechtel invest in an endowment fund to manage Tulare Hill in perpetuity, rather than settle for their proposed 30-year monitoring of impacts. However, if the NOx deposition, or some other contaminant borne in the stack effluent, destroys the existing ecological relationships of Tulare Hill, then an endowment to manage Tulare Hill in perpetuity may be badly spent in perpetuity. I encourage the CEC to consider recommending a more rigorously described monitoring program to ensure that we learn about the impacts of such an energy facility on the ecological community that is adapted to serpentine soils. We also need to learn about the impacts of the 145-foot-tall stacks. Monitoring their impacts on birds for three years will not be helpful if it turns out that intolerable numbers of migrating birds are colliding with the stacks. Something would need to be done about it (see my discussions of Adaptive Management and Changed Circumstances).

Spiegel points out that serpentine-based rock represents 1% of California's geologic base, yet contains 10% of California's floral species. The proposed Metcalf Energy Center is *unique* among energy facilities permitted by CEC in that it poses impacts to this serpentine-grassland complex that supports 10 times the average floral species richness across the other 99% of California. This proposed facility would also be unique for threatening the contiguity of habitat between the serpentine soils of the Santa Cruz Mountains and the Diablo Range. Tulare Hill is recognized as the site of a satellite population of Bay Checkerspot Butterfly (USFWS 1998), so its degradation as habitat would contribute to habitat fragmentation of Bay Checkerspot Butterfly (Wilcox and Murphy 1985, Weiss cf in CH2MHILL 2000). This is a serious problem, of which CEQA requires careful, in-depth analysis. Much more work is needed to meet CEQA standards.

Given the lack of empirically based knowledge on NOx and other pollutants on serpentine-based communities, it would be especially prudent, in accordance with CEQA's high standards, to establish a scientifically defensible monitoring program, including out-of-area control sites and both an impact-gradient design and before/after-control/impact (BACI) pairs design. In other words, I recommend that distance to source be factored into the sampling design, as well as before and after sampling at both Tulare Hill and the control sites. Without these types of designs, the monitoring program will be pseudoreplicated and unlikely to be informative (Hurlbert 1984). Data collected in an adequate monitoring program would likely include the following variables:

- Nitrogen deposition rates
- Soil chemistry
- Biological species composition

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- Plant biomass
- Plant height
- Plant density
- Root depth
- Incidence of disease
- Numerical distributions of dependent fauna, including Bay Checkerspot Butterfly and Opler's Longhorn Moth.

Additional variables would likely also be important, but they all need to be identified and described now, not later. These variables would also need to be collected at elevations spanning the bottom to top of Tulare Hill and at locations spanning the north-south breadth of the Hill. This design would need to be repeated on the comparison, control sites. This type of a rigorous sampling design would cost more than \$30,000/year. Outside (non Calpine-Bechtel) employees should conduct the monitoring work.

CEC Staff Proposed Mitigation

I recommend that staff consider a 1:1 conservation-to-take ratio of the upland area to be converted to the power plant, laydown area and access roads. This area may be disturbed, but upland areas next to water channels, disturbed or not, are important dispersal areas for wildlife. This upland area could be used for aestivation and dispersal by California tiger salamander and red-legged frog. Another nearby upland area that is adjacent to a stream should be conserved in equal area and in perpetuity (or until the hydrological system has changed locations and relief).

Similar to the recommended endowment fund, I recommend that the CEC require a fund to be available for *changed circumstances*. Alternative management strategies might be needed to mitigate the impacts of NOx depositions onto Tulare Hill. For example, if exotic weeds colonize Tulare Hill in response to nitrogen augmentation, then Calpine-Bechtel might need to perform weed management in support of the food plants of Bay Checkerspot Butterfly and Opler's Longhorn Moth. In another example, if the MEC's stacks cause an intolerable number of migratory bird collisions, then additional mitigation would be needed, or changes to the stacks might be needed.

Conclusions

Although it is far too early for any final conclusions, generally speaking we have gotten off to a good start in this preliminary phase. But a lot more hard, thorough, and unbiased (or biased in favor of the environment) work is necessary.

Tables 1 and 2 summarize my comments and recommendations on this Preliminary Staff Assessment and on the applicant's documents.



Shawn Smallwood, Ph.D.

6-29-00

Date

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Table 1. Status of PSA, and some of the consequence of existing shortfalls.

Defect of PSA and applicant documents	Evidence	Consequence
1. Biological surveys are incomplete	No sampling methods were described for bats and small, non-volant mammals	The environmental setting remains incompletely described, thus the project impacts remain incompletely described
2. Baseline environmental conditions are too recent and narrowly described	Photos of the site from 1992 depict a more lush vegetation on Tulare Hill and the MEC site; I found species that CH2MHILL and CEC biologists did not find	The environmental setting remains incompletely described, and the impacts are assumed smaller than they will really be
3. The numerical/spatial distribution of ground squirrels was inaccurately described	Contrary to CH2MHILL (2000), I saw ground squirrels across the upland area and the extent of Tulare Hill	Ground squirrels are keystone species, and their burrows are used by California red-legged frog and California tiger salamander. Therefore, the PSA underestimates potential impacts
4. The likelihood of California red-legged frogs occurring in Fisher Creek is underestimated	Ample scientific reports exist that refute the claim of CH2MHILL (2000) that the presence of bullfrogs negates the presence of California red-legged frogs	The PSA and supporting applicant documents downplay the potential of red-legged frogs to occur at this site
5. The hazards of the MEC stacks and new power lines to birds are underestimated	During one of two site visits I found an injured Common Raven under a transmission tower; Scientific reports are available to refute the claim that the stacks and transmission lines will not be a hazard because they will be below the highest elevation of Tulare Hill	The impacts to nocturnally migratory birds are downplayed and trivialized
6. Indirect impacts are inadequately assessed	The effects of increased lighting and noise are mentioned, but the scientific evidence of their relative effects are is not	The impacts of increased lighting and noise are downplayed and underestimated
7. Cumulative impacts are inadequately assessed	The standards of McCold and Holman (1995) and Smallwood et al. (1999) were unmet	Cumulative impacts are downplayed and underestimated
8. The mitigation measures are misdirected and will be ineffective	The upland area next to Fisher Creek is not included in the conservation-to-take ratio, nor is the entire area of NOx deposition; HCPs are mitigation plans for take permits and defer formulation of mitigation measures to a later date	The types of land being conserved do not match the lands being effected; Funding an HCP promotes more environmental impacts
9. Adaptive management is improperly described	>80 scientific publications describe adaptive management as a structured process designed to enable learning of manipulated environments, and to respond with planned alternative prescriptions; Adaptive management described by the applicant appears to be remedial trial-and-error	The applicant's plan will not enlighten the CEC about the effects of cattle management on Tulare Hill, so appropriate alternative management strategies will be unlikely applied

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10.	The proposed monitoring plan is inadequate	The applicant describes no design attributes of the monitoring	Little will be learned from the monitoring and the lack of thresholds of significance will likely preclude any remedial actions to disturbing trends
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Table 2. My recommendations for amending the PSA and applicant documents prior to approval of the MEC.

Issue	Recommendation
1	Proper sampling methods should be implemented for bats and small, non-volant mammals, and at the appropriate spatial and temporal scales
2	The regional and temporal context of the site needs to be described more thoroughly and realistically, including the inter-annual cyclicity of the weather patterns, the likely former biological occupants of the site, and the possible future occupants after the site use is changed
3	Ground squirrel burrows should be counted and mapped, and a burrow probe used to view the interiors for special status species during repeat visits
4	The literature on California red-legged frogs and California tiger salamander should be reviewed for the impacts of bullfrogs on these species, and agency-protocol surveys should be made of Fisher Creek on site and up- and down-stream of the site
5	Monitoring of the avian impacts of existing power lines, maintained by PG&E, should be implemented immediately, or existing monitoring data examined (if they exist); The literature and experts on avian impacts with tall structures should be consulted and a more realistic impact assessment conducted; A reasonable mitigation plan should be formulated
6	The scientific literature on artificial noise and lighting should be thoroughly reviewed, and indirect impacts assessment conducted, and a reasonable mitigation plan formulated
7	A cumulative impacts assessment is needed, and should meet the standards of McCold and Holman (1995) and Smallwood et al. (1999); The ecological indicators approach would be appropriate to assess the likely areas of impact from NOx deposition (see Zhang et al. 1998)
8	The proposal to fund an HCP as mitigation for this project should be rejected; An endowment fund should be established for long-term, scientifically defensible monitoring, as well as changed circumstances; Real adaptive management should be formulated and implemented; Conservation-to-take ratios should factor in the entire area of NOx deposition, as well as the type of physiography converted to the MEC
9	The scientific literature on adaptive management should be reviewed, and a real adaptive management plan formulated for cattle management on Tulare Hill
10	A detailed monitoring plan should be described prior to project approval, and should include attributes of impact-gradient design and before/after-control/impact (BACI) pairs, detailed descriptions of variables to be measured, out-of-area control sites, identification of who will conduct the monitoring (qualified expert[s] not employed by Calpine-Bechtel), thresholds of significance for making management adjustments, and integration into a well-described adaptive management plan

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References

- Beier, P. 1995. Dispersal of juvenile cougars in fragmented habitat. *Journal of Wildlife Management* 59:228-237.
- Bergen, F. and M. Abs. 1997. Etho-ecological study of the singing activity of the blue tit (*Parus caeruleus*), great tit (*Parus major*) and chaffinch (*Fringilla coelebs*). *Journal fuer Ornithologie* 138:451-467.
- Buchanan, B. W. 1993. Effects of enhanced lighting on the behaviour of nocturnal frogs. *Animal Behaviour* 45: 893-899.
- CH2MHILL. 2000. Biological assessment for the Metcalf Energy Center Project, Santa Clara County, California. Calpine Corporation and Bechtel Enterprises Holdings, Inc., Pleasanton, California.
- Contor, C. R. and J. S. Griffith 1995. Nocturnal emergence of juvenile rainbow trout from winter concealment relative to light intensity. *Hydrobiologia* 299: 179-183.
- Derrickson, K. C. 1988. Variation in repertoire presentation in northern mockingbirds. *Condor* 90: 592-606.
- Frank, K. D. 1988. Impact of outdoor lighting on moths: An assessment. *Journal of the Lepidopterists' Society* 42: 63-93.
- Gorenzel, W. P. and T. P. Salmon. 1995. Characteristics of American Crow urban roosts in California. *Journal of Wildlife Management* 59: 638-645.
- Holling, C. S. (ed.). 1978. Adaptive environmental assessment and management. John Wiley & Sons, New York.
- Hoving, E. J. and S. G. Sealy. 1987. Species and age composition of a sample of birds killed in Fall 1979 at a Manitoba [Canada] TV tower. *Prairie Naturalist* 19: 129-134.
- Hurlbert, S.H. 1984. Pseudoreplication and the design of ecological field experiments. *Ecological Monographs* 54:187-211.

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- Klotz, J. H. and B. L. Reid. 1993. Nocturnal orientation in the black carpenter ant *Camponotus pennsylvanicus* Degeer (Hymenoptera: Formicidae). *Insectes Sociaux* 40: 95-106.
- Lancia, R.A., C.E. Braun, M.W. Collopy, R.D. Dueser, J.G. Kie, C.J. Martinka, J.D. Nichols, T.D. Nudds, W.R. Porath, and N.G. Tilghman. 1996. ARM! For the future: adaptive resource management in the wildlife profession. *Wildlife Society Bulletin* 24:436-442.
- Manville, A.M., II. 2000. The ABCs of avoiding bird collisions at communication towers: the next steps. Proceedings of the Avian Interactions Workshop, December 2, 1999, Charleston, SC. Electric Power Research Institute (EPRI), Palo Alto, California.
- McCold, L., and J. Holman. 1995. Cumulative impacts in environmental assessments: how well are they considered? *The Environmental Professional* 17:2-8.
- McLain, R.J. and R.G. Lee. 1996. Adaptive management: promises and pitfalls. *Environmental Management* 20:437-442.
- Rydell, J. and H. J. Baagoe. 1996. Street lamps increase bat predation on moths. *Entomologisk Tidskrift* 117: 129-135.
- Shilling, F. 1997. Do Habitat Conservation Plans protect Endangered species? *Science* 276:1662-1663.
- Smallwood, K.S. 2000. A crosswalk from the Endangered Species Act to the HCP Handbook and real HCPs. *Environmental Management* 26, Supplement 1:23-35.
- Smallwood, K.S., J. Beyea, and M. Morrison. 1999. Using the best scientific data for endangered species conservation. *Environmental Management* 24:421-435.
- Summers, C. G. 1997. Phototactic behavior of *Bemisia argentifolii* (Homoptera: Aleyrodidae) crawlers. *Annals of the Entomological Society of America* 90:372-379.
- Taylor, R.A.J. and L.R. Taylor. 1979. A behavioral model for the evolution of spatial dynamics. Pages 1-28 *in* R.M. Anderson, B.D. Turner, and L.R. Taylor (eds.) *Population dynamics*. Blackwell Scientific Publications, Oxford, U.K.

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USFWS (United States Fish and Wildlife Service). 1998. Draft Recovery Plan for serpentine soil species of the San Francisco Bay Area. Sacramento, California.

Walters, C.J. 1986. Adaptive management of renewable resources. McGraw-Hill, New York.

Wilcox, B.A., and D.D. Murphy. 1985. Conservation strategy: the effects of fragmentation on extinction. *American Naturalist* 125:879-887.

Zhang, M., S. Geng, and K.S. Smallwood. 1998. Nitrate contamination in groundwater of Tulare County, California. *Ambio* 74:170-174.

Short Biography of Shawn Smallwood, Ph.D.

Dr. Shawn Smallwood is an ecologist with 15 years of professional experience with wildlife, ecosystems, and endangered species issues. He has authored 73 publications, more than half of which were peer-reviewed. He has served as Associate Editor and Editorial Board Member of two international scientific journals, and he has reviewed many professional papers. Dr. Smallwood understands what it takes to produce scientifically defensible research, survey and monitoring results, as well as impacts assessments.

Dr. Smallwood's work has focused on both endangered species conservation and animal damage control. He has worked to conserve such state or federally threatened species as red-legged frogs, giant garter snakes, Swainson's Hawks, and Northern Goshawks. He has also developed lethal and non-lethal methods to control pocket gophers and many other species. Since 1985, he has also conducted the California track count for monitoring the statewide numerical and spatial trends of mountain lions, bobcats, coyotes, gray fox, black bear, and other mammalian Carnivores, as well as for deer. Dr. Smallwood also developed quantitative methods to identify individual animals by their tracks, and he developed new monitoring and counting methods for pocket gophers and other fossorial animals. He developed a new quantitative measure of treatment effect for use in animal damage control efforts. He also conducted his Ph.D. thesis research on exotic species, particularly those that species of mammals and birds that invaded California and caused economic or environmental damage.

Dr. Smallwood also applies the tenets of landscape ecology to his work, and develops ecological indicators for use with GIS. Dr. Smallwood has integrated GPS into his field studies, and has developed new statistical procedures for analyzing spatial data. Dr. Smallwood is also one of the world's leading experts on animal density and spatial patterns of distribution, and he has an extensive collection of density and numerical estimates published for many species of mammal, bird, reptile and amphibian. He uses these estimates to predict patterns of spatial distribution for species with which he works in the field, and he uses them to interpret patterns observed in his field work. Dr. Smallwood also works on operationalizing the habitat concept, and focuses research on how to accurately quantify the selection and use of habitat by animal species.

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Much of Dr. Smallwood's consulting work has centered on assessing the foundation of conclusions in environmental documents prepared by project proponents and their consultants. He works to protect the interests of stake-holder groups by assessing the impacts of completed, ongoing and proposed projects and he assesses the adequacy of related environmental documents. He has served as an expert witness in litigation against the nuclear weapons industry and the chemical manufacturing industry, as well as against ocean floor dredging and an airport expansion, for example. Dr. Smallwood has written numerous expert reports, declarations, and depositions, and has testified often before attorneys, City Councils, County Supervisors and other governmental bodies.

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Photo 1 arboreal salamander next to Fisher Creek. This species was not reported by the applicant or the applicant's consultants.

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Photo 2 Harvester ant colonies were abundant on Tulare Hill, which is significant because harvester ants are the main prey of California horned lizards, a Species of Special Concern.

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Photo 3 Grass was taller on Tulare Hill in April 1992



Photo 4 compared to April 2000

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Photo 5 The site of the proposed Metcalf Energy Center had less junk on it in 1992



Photo 6 compared to 2000, and the vegetation was more lush

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Photo 7 In April 1992, the oaks and shrubs were more lush, and the grass taller, in this view from the east of the spring on Tulare Hill



Photo 8 compared to April 2000

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Photo 9 On the west side of Fisher Creek, the grass was taller and trees more lush in 1992.



Photo 10 In 2000, sow thistle dominates the ground cover.

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Photo 11 Common Raven injured under a transmission tower on Tulare Hill, indicating that the risk of avian impact with the stacks and new transmission cables

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Kenneth Shawn Smallwood Curriculum Vitae

109 Luz Place
Davis, CA 95616
Phone (530) 756-4598
puma@davis.com

Born May 3, 1963 in
Sacramento, California.
Married, father of two children.

Affiliations: Consulting in the Public Interest, www.cipi.com
Biological Sciences Department, California State University, Sacramento
Bioresources Consulting
Institute for Sustainable Development
Chairman, Conservation Affairs Committee, The Wildlife Society--Western Section

Disciplines:

Wildlife, ecosystem and landscape ecology; conservation biology; sampling methods and systems analysis; animal damage management.

Education:

Ph.D. Ecology, University of California, Davis. September 1990.
M.S. Ecology, University of California, Davis. June 1987.
B.S. Anthropology, University of California, Davis. June 1985.
Corcoran High School, Corcoran, California. June 1981.

Experience:

- 73 professional publications, 38 peer-reviewed
- 7 professional papers currently under peer-review
- 44 public presentations of research results at professional meetings

Part-time Faculty, 1/98 to present, California State University, Sacramento. I've taught Contemporary Environmental Issues, Natural Resources Conservation, Mammalogy, and Ornithology Lab.

Systems Ecologist, 7/96 to present, *Consulting in the Public Interest*. I am part of a multi-disciplinary consortium of scientists who facilitate large-scale, environmental planning projects and litigation. We provide risk assessments, assessments of management practices, and expert witness testimony.

Systems Ecologist, 1/95 to present, *Institute for Sustainable Development*. I head ISD's program on integrated resources management. I develop indicators of ecological integrity for large areas, using remotely sensed data, local community involvement and GIS.

Editorial Board Member, *Environmental Management*, 10/99 to present.

Lead Scientist, 6/96 to 6/99, *National Endangered Species Network*. I headed NESN's efforts to inform academic scientists and environmental activists about emerging issues regarding the Endangered Species Act and other environmental laws pertaining to legally rare species. I also testified at public hearings on behalf of environmental groups and endangered species.

Ecologist, 1/97 to 6/98, *Western Foundation of Vertebrate Zoology*. I conducted field research to determine the impact of past mercury mining on the status of red-legged frogs in Santa Clara County, California.

Associate Editor, *Biological Conservation*, 9/94 to 9/95. Administered independent scientific reviews of submitted, professional papers in ecology and conservation biology, and made recommendations to the Editors.

Senior Systems Ecologist, 7/94 to 12/95, *EIP Associates*, Sacramento, California. Provided consulting services in environmental planning. I also developed a quantitative assessment of land units for their conservation and restoration opportunities, using the ecological resource requirements of 29 legally rare species. I mapped vegetation and land use, and derived new spatial data from a GIS overlay of these variables with soil types, flood zones, roads, and other spatially referenced data. Using these derived data, I developed a set of indicators for prioritizing areas within Yolo County that will receive mitigation funds for habitat easements and restoration.

Post-Graduate Researcher, 10/90 to 6/94, with Dr. Shu Geng, *Department of Agronomy and Range Science, U.C. Davis*. Studied landscape and management effects on temporal and spatial patterns of abundance among pocket gophers and species of Falconiformes and Carnivora in the Sacramento Valley. I also developed and analyzed a data base of energy use in California agriculture, and I assisted with a landscape (GIS) study of groundwater contamination across Tulare County, California.

Co-teacher, 1/91 to 6/91 and 1/93 to 6/93, *Graduate Group in Ecology, U.C. Davis*. Co-taught conservation biology with Dr. Christine Schonewald.

Reader, 3/90 to 6/90, *Department of Psychology, U.C. Davis*. Assisted students of Psychobiology (taught by Dr. Richard Coss) with research and writing term papers.

Research Assistant, 11/88 to 9/90, with Dr. Walter E. Howard, *Department of Wildlife and Fisheries Biology, U.C. Davis*. Tested durable baits for pocket gopher control in forest plantations, and developed gopher sampling methods.

Fulbright Research Fellow, Indonesia, 7/88 to 11/88. Tested use of new sampling methods for monitoring the number of Sumatran tigers, and evaluated methods used by other researchers.

Research Assistant, 7/87 to 6/88, with Dr. Terrell P. Salmon, *Wildlife Extension, Department of Wildlife and Fisheries Biology, U.C. Davis*. Developed empirical models of mammal and bird invasions in North America, and a rating system for priority research and control of exotic species based on economic, environmental, and human health hazards in California.

Student Assistant, 3/85 to 6/87, with Dr. E. Lee Fitzhugh, *Wildlife Extension, Department of Wildlife and Fisheries Biology, U.C. Davis*. Developed and implemented a statewide mountain lion track count for long-term monitoring of numbers and distribution. Also developed quantitative techniques to identify individual mountain lions by their tracks, and to differentiate mountain lion and dog tracks.

Projects

Comments on environmental documents. I have been retained to comment on various environmental documents, including the Headwaters HCP, San Diego MSCP, Natomas Basin HCP, Giant Garter Snake Recovery Plan, Arroyo Southwestern Toad Recovery Plan, Peninsular Range Bighorn Sheep Recovery Plan, Ballona Wetlands Environmental Impact Report, Turn of the Century Environmental Impact Report, The California Board of Forestry's proposed amended Forest Practices Rules, the Negative

Declaration for the Sunset Sky ranch Airport Use Permit, and the California Energy Commission's Preliminary Staff Assessment of the proposed Metcalf Energy Center. I have testified before the California Coastal Commission, County Boards of Supervisors, and City Councils, and I have participated with press conferences.

Workshops on HCPs. Assisted Dr. Michael Morrison with organizing and conducting a 2-day workshop on Habitat Conservation Plans, and another 1-day workshop. These Workshops were attended by academics, attorneys, and consultants with HCP experience. We guest-edited a Proceedings to be published in Environmental Management.

Mapping of wind turbines and biological resources at Altamont Pass. Using GPS and GIS to map and study environmental impacts of 1,400 wind turbines.

Mapping of biological resources along Highways 46 and 41. Using GPS and GIS to delineate vegetation complexes and locations of special status species along 26 miles of highway in San Luis Obispo County, and in a large area north of Fresno.

Mercury effects on Red-legged Frog. Assisted Dr. Michael Morrison and US Fish and Wildlife Service in assessing the possible impacts of Santa Clara County's historical mercury mining on the federally listed red-legged frog. Also measured habitat in numerous streams.

Opposition to proposed No Surprises rule. Wrote a white paper and summary letter explaining scientific grounds for opposing the incidental take permit (ITP) rules providing ITP applicants and holders with general assurances they will be free of compliance with the Endangered Species Act once they adhere to the terms of a "properly functioning HCP." I obtained 188 signatures of scientists and environmental professionals on the letter submitted to the US Fish and Wildlife Service and the National Marine Fisheries Service. The letter was also provided to all US Senators. It helped change the prevailing view of HCPs as beneficial to listed species.

Natomas Basin Habitat Conservation Plan alternative. Designed narrow channel marsh to increase likelihood of survival and recovery in the wild of giant garter snake, Swainson's hawk and Valley Elderberry Longhorn Beetle. Design included replication and interspersed treatments for experimental testing of critical habitat elements. Provided report to Northern Territories, Inc.

Cook et al. v. Rockwell International et al., No. 90-K-181 (D. Colorado). Providing expert testimony on the role of burrowing animals in affecting the fate of buried and surface-deposited radioactive and hazardous chemical wastes at the Rocky Flats Plant, Colorado. Provided expert report based on three site visits and the most extensive document review of burrowing animals ever conducted. Conducted transect surveys for evidence of burrowing animals and other wildlife on and around waste facilities. Discovered substantial intrusion of waste structures by burrowing animals.

Hanford Nuclear Reservation Litigation. Providing expert testimony on the role of burrowing animals in affecting the fate of buried radioactive wastes at the Hanford Nuclear Reservation, Washington. Provided three expert reports based on three site visits and extensive document review. Predicted and verified population density of pocket gophers on buried waste structures, as well as incidence of radionuclide contamination in body tissue. Conducted transect surveys for evidence of burrowing animals and other wildlife on and around waste facilities. Discovered substantial intrusion of waste structures by burrowing animals.

Assessment of Environmental Technology Transfer to China, and Assessment of Agricultural Production System. Twice traveled to China and interviewed scientists, industrialists, agriculturalists, and the

Directors of the Chinese Environmental Protection Agency and the Department of Agriculture to assess the need and possible pathways for environmental clean-up technologies and trade opportunities between the US and China. Spent a total of five weeks in China, including in Shandong and Linxion Provinces and in Beijing.

Yolo County Habitat Conservation Plan. Conducted the landscape ecology study of Yolo County to identify the priority land units to receive mitigation so as to most improve the ecosystem functionality within the County from the perspective of 29 legally rare species of wildlife. Used a hierarchically structured indicators approach to apply principles of landscape and ecosystem ecology, conservation biology, and local values in rating land units. Derived GIS maps to help guide the conservation area design, and then I developed implementation strategies.

Mountain Lion Track Count. Developed and conducted the carnivore monitoring program throughout California since 1985. Species counted include mountain lion, bobcat, black bear, coyote, red and gray fox, raccoon, striped skunk, badger, and black-tailed deer. Vegetation and land use are also monitored. The transect was established on dusty, dirt roads within randomly selected quadrats. These roads are searched for tracks of the carnivores, which routinely use the roads for travel paths.

Sumatran Tiger and other Felids. Designed and conducted track counts for seven species of wild cats in Sumatra, including the Sumatran tiger, fishing cat, and golden cat. Spent four months on Sumatra and Java, and learned Bahasa Indonesia (the official Indonesian language). I was awarded a Fulbright Research Fellowship to complete the project.

Wildlife in Agriculture. Beginning as my post-graduate research, I have studied pocket gophers and other wildlife in 40 alfalfa fields throughout the Sacramento Valley, and I surveyed for wildlife along a 200 mile road transect for six years. The data were analyzed using GIS and methods from landscape ecology, and the results were published and presented orally to farming groups in California and elsewhere. I also conducted the first study of wildlife in cover crops used on vineyards and orchards.

Representative Clients

Law offices and environmental groups

Law Offices of Berger & Montague
 Law Offices of Roy Haber
 Law Offices of Edward MacDonald
 Law Office of John Gabrielli
 California Wildlife Federation
 Defenders of Wildlife
 Sierra Club
 National Endangered Species Network
 Spirit of the Sage Council
 The Humane Society
 Californians for Renewable Energy
 Goldberg, Kamin & Garvin, Attorneys at Law
 Environmental Protection Information Center (EPIC)

Government agencies

US Department of Agriculture
 US Forest Service
 US Fish & Wildlife Service
 California Department of Fish & Game
 California Department of Transportation
 California Department of Forestry
 California Department of Food & Agriculture
 Sustainable Agriculture Research & Education Program
 County of Yolo
 Tahoe Regional Planning Agency

Businesses

Pacific Gas & Electric Co.
 Southern California Edison Co.
 Georgia-Pacific Timber Co.
 Northern Territories Inc.
 National Renewable Energy Lab

Agricultural Energy Use and Tulare County Groundwater Study. Developed and analyzed a data base of energy use in California agriculture, and collaborated on a landscape (GIS) study of groundwater contamination across Tulare County, California.

Pocket Gopher Damage in Forest Clearcuts. Tested various poison baits and baiting regimes for pocket gopher control in forest plantations, and developed gopher sampling methods. Conducted the most extensive field study of pocket gophers ever, involving thousands of gophers in 68 research plots on 55 clearcuts among 6 National Forests in northern California.

Risk Assessment of Exotic Species in North America. Developed empirical models of mammal and bird species invasions in North America. Developed a rating system for assigning priority research and control to exotic species in California, based on economic, environmental, and human health hazards.

Peer-Reviewed Publications:

Zhang, M., K. S. Smallwood, and E. Anderson. Relating indicators of ecological health and integrity to assess risks to sustainable agriculture and native biota. International Conference on Ecosystem Health.

Smallwood, K.S. and S. Geng. Pocket gopher (*Thomomys bottae*) density in alfalfa. Agriculture, Ecosystems & Environment: Accepted.

Smallwood, K.S. 2000. Ecological restoration in the context of animal demographic units and their habitat areas. *Restoration Ecology* : Accepted.

Smallwood, K.S. 2001. Habitat models based on numerical comparisons. In Predicting species occurrences: Issues of scale and accuracy, J. M. Scott, P. J. Heglund, M. Morrison, M. Raphael, J. Haufler, and B. Wall, editors. Island Press, Covello, California.

Smallwood, K.S. 2000. A crosswalk from the Endangered Species Act to the HCP Handbook and real HCPs. *Environmental Management* 26, Supplement1:23-35.

Smallwood, K.S., J. Beyea and M. Morrison. 1999. Using the best scientific data for endangered species conservation. *Environmental Management* 24:421-435.

Smallwood, K.S. 1999. Scale domains of abundance among species of Mammalian Carnivora. *Environmental Conservation* 26:102-111.

Smallwood, K.S. 1999. Study attributes for making useful population density estimates. *Transactions of the Western Section of the Wildlife Society* 35: Accepted.

Smallwood, K.S. and M.L. Morrison. 1999. Estimating burrow volume and excavation rate of pocket gophers (Geomyidae). *Southwestern Naturalist* 44:173-183.

Smallwood, K.S. and M.L. Morrison. 1999. Spatial scaling of pocket gopher (*Geomyidae*) density. *Southwestern Naturalist* 44:73-82.

- Smallwood, K.S. 1999. Abating pocket gophers (*Thomomys* spp.) to regenerate forests in clearcuts. *Environmental Conservation* 26:59-65.
- Smallwood, K.S. 1998. Patterns of black bear abundance. *Transactions of the Western Section of the Wildlife Society* 34:32-38.
- Smallwood, K.S. 1998. On the evidence needed for listing northern goshawks (*Accipiter gentilis*) under the Endangered Species Act: a reply to Kennedy. *J. Raptor Research* 32:323-329.
- Smallwood, K.S., B. Wilcox, R. Leidy, and K. Yarris. 1998. Indicators assessment for Habitat Conservation Plan of Yolo County, California, USA. *Environmental Management* 22: 947-958.
- Smallwood, K.S., M.L. Morrison, and J. Beyea. 1998. Animal burrowing attributes affecting hazardous waste management. *Environmental Management* 22: 831-847.
- Smallwood, K.S. and C.M. Schonewald. 1998. Study design and interpretation for mammalian carnivore density estimates. *Oecologia* 113:474-491.
- Zhang, M., S. Geng, and K.S. Smallwood. 1998. Nitrate contamination in groundwater of Tulare County, California. *Ambio* 27(3):170-174.
- Smallwood, K.S. and M.L. Morrison. 1997. Animal burrowing in the waste management zone of Hanford Nuclear Reservation. *Proceedings of the Western Section of the Wildlife Society Meeting* 33:88-97.
- Morrison, M.L., K.S. Smallwood, and J. Beyea. 1997. Monitoring the dispersal of contaminants by wildlife at nuclear weapons production and waste storage facilities. *The Environmentalist* 17:289-295.
- Smallwood, K.S. (1997) Interpreting puma (*Puma concolor*) density estimates for theory and management. *Environmental Conservation* 24(3):283-289.
- Smallwood, K.S. 1997. Managing vertebrates in cover crops: a first study. *American Journal of Alternative Agriculture* 11:155-160.
- Smallwood, K.S. and S. Geng. 1997. Multi-scale influences of gophers on alfalfa yield and quality. *Field Crops Research* 49:159-168.
- Smallwood, K.S. and C. Schonewald. 1996. Scaling population density and spatial pattern for terrestrial, mammalian carnivores. *Oecologia* 105:329-335.
- Smallwood, K.S., G. Jones, and C. Schonewald. 1996. Spatial scaling of allometry for terrestrial, mammalian carnivores. *Oecologia* 107:588-594.
- Van Vuren, D. and K.S. Smallwood. 1996. Ecological management of vertebrate pests in agricultural systems. *Biological Agriculture and Horticulture* 13:41-64.
- Smallwood, K.S., B.J. Nakamoto, and S. Geng. 1996. Association analysis of raptors on an agricultural landscape. Pages 177-190 in D.M. Bird, D.E. Varland, and J.J. Negro, eds., *Raptors in human landscapes*. Academic Press, London.

- Erichsen, A.L., K.S. Smallwood, A.M. Commandatore, D.M. Fry, and B. Wilson. 1996. White-tailed Kite movement and nesting patterns in an agricultural landscape. Pages 166-176 in D.M. Bird, D.E. Varland, and J.J. Negro, eds., *Raptors in human landscapes*. Academic Press, London.
- Smallwood, K.S. 1996. Assessment of the BIOPORT model's parameter values for pocket gopher burrowing characteristics. Report to Berger & Montague, P.C. and Roy S. Haber, P.C., Philadelphia.
- Smallwood, K.S. 1995. Scaling Swainson's hawk population density for assessing habitat-use across an agricultural landscape. *J. Raptor Research* 29:172-178.
- Smallwood, K.S. and W.A. Erickson. 1995. Estimating gopher populations and their abatement in forest plantations. *Forest Science* 41:284-296.
- Smallwood, K.S. and E.L. Fitzhugh. 1995. A track count for estimating mountain lion *Felis concolor californica* population trend. *Biological Conservation* 71:251-259
- Smallwood, K.S. 1994. Site invasibility by exotic birds and mammals. *Biological Conservation* 69:251-259.
- Smallwood, K.S. 1994. Trends in California mountain lion populations. *The Southwestern Naturalist* 39:67-72.
- Smallwood, K.S. 1993. Understanding ecological pattern and process by association and order. *Acta Oecologica* 14(3):443-462.
- Smallwood, K.S. and E.L. Fitzhugh. 1993. A rigorous technique for identifying individual mountain lions *Felis concolor* by their tracks. *Biological Conservation* 65:51-59.
- Smallwood, K.S. 1993. Mountain lion vocalizations and hunting behavior. *The Southwestern Naturalist* 38:65-67.
- Smallwood, K.S. and T.P. Salmon. 1992. A rating system for potential exotic vertebrate pests. *Biological Conservation* 62:149-159.
- Smallwood, K.S. 1990. Turbulence and the ecology of invading species. Ph.D. Thesis, University of California, Davis.

Other Publications

- Morrison, M.L., and K.S. Smallwood. 1999. NTI plan evaluation and comments. Exhibit C in W.D. Carrier, M.L. Morrison, K.S. Smallwood, and Vail Engineering. Recommendations for NBHCP land acquisition and enhancement strategies. Northern Territories, Inc., Sacramento.
- Smallwood, K. S. 1998. 1998 California Mountain Lion Track Count. Report to the Defenders of Wildlife, Washington, D.C. 5 pages.

- Smallwood, K.S. 1998. Comment on the Pacific Lumber Company HCP and EIR. Commissioned by Sierra Club and EPIC. 28 pp.
- Smallwood, K.S. 1998. Draft report of a visit to a paint sludge dump site near Ridgewood, New Jersey, February 26th, 1998. Unpublished report to Consulting in the Public Interest.
- Smallwood, K.S. 1998. Review of the Draft Recovery Plan for the Arroyo Southwestern Toad (*Bufo microscaphus californicus*). Commissioned by National Endangered Species Network and Spirit of the Sage Council, Pasadena, California.
- Smallwood, K.S. 1998. Science missing in the “no surprises” policy. Commissioned by National Endangered Species Network and Spirit of the Sage Council, Pasadena, California.
- Smallwood, K.S. 1998. Davis Visions. The Flatlander, Davis, California.
- Smallwood, K.S. 1997. Last grab for Yolo’s land and water. The Flatlander, Davis, California.
- Smallwood, K.S. 1997. Science missing in the “no surprises” policy. Commissioned by National Endangered Species Network and Spirit of the Sage Council, Pasadena, California.
- Smallwood, K.S. and M.L. Morrison. 1997. Alternate mitigation strategy for incidental take of giant garter snake and Swainson’s hawk as part of the Natomas Basin Habitat Conservation Plan. Pages 6-9 and *iii* illustrations in W.D. Carrier, K.S. Smallwood and M.L. Morrison, Natomas Basin Habitat Conservation Plan: Narrow channel marsh alternative wetland mitigation. Northern Territories, Inc., Sacramento.
- Smallwood, K.S. 1997. Spatial scaling of pocket gopher (Geomyidae) burrow volume. Abstract in Proceedings of 44th Annual Meeting, Southwestern Association of Naturalists. Department of Biological Sciences, University of Arkansas, Fayetteville.
- Smallwood, K.S. 1997. Estimating prairie dog and pocket gopher burrow volume. Abstract in Proceedings of 44th Annual Meeting, Southwestern Association of Naturalists. Department of Biological Sciences, University of Arkansas, Fayetteville.
- Smallwood, K.S. 1997. Animal burrowing parameters influencing toxic waste management. Abstract in Proceedings of Meeting, Western Section of the Wildlife Society.
- Smallwood, K.S. 1997. Assessment of plutonium releases from Hanford buried waste sites. Report Number 9, Consulting in the Public Interest, 53 Clinton Street, Lambertville, New Jersey, 08530.
- Smallwood, K.S. 1996. Soil Bioturbation and Wind Affect Fate of Hazardous Materials that were Released at the Rocky Flats Plant, Colorado. Report to Berger & Montague, P.C., Philadelphia.
- Smallwood, K.S. 1996. Second assessment of the BIOPORT model's parameter values for pocket gopher burrowing characteristics and other relevant wildlife observations. Report to Berger & Montague, P.C. and Roy S. Haber, P.C., Philadelphia.

- Smallwood, K.S., and Bruce Wilcox. 1996. Study and interpretive design effects on mountain lion density estimates. Abstract in the *Proceedings 5th Mountain Lion Workshop*.
- Smallwood, K.S., and Bruce Wilcox. 1996. Ten years of mountain lion track survey. Abstract in the *Proceedings 5th Mountain Lion Workshop*.
- Smallwood, K.S., and M. Grigione. 1997. Photographic recording of mountain lion tracks. *Proceedings 5th Mountain Lion Workshop*.
- Smallwood, K.S., B. Wilcox, and J. Karr. 1995. An approach to scaling fragmentation effects. Brief 8, Ecosystem Indicators Working Group, 17 March, 1995. Institute for Sustainable Development, Thoreau Center for Sustainability – The Presidio, PO Box 29075, San Francisco, CA 94129-0075.
- Wilcox, B., and K.S. Smallwood. 1995. Ecosystem indicators model overview. Brief 2, Ecosystem Indicators Working Group, 17 March, 1995. Institute for Sustainable Development, Thoreau Center for Sustainability – The Presidio, PO Box 29075, San Francisco, CA 94129-0075.
- EIP Associates. 1995. Yolo County Habitat Conservation Plan Biological Resources Report. Yolo County Planning and Development Department, Woodland, California.
- EIP Associates. 1996. Yolo County Habitat Conservation Plan. Yolo County Planning and Development Department, Woodland, California.
- Smallwood, K.S. and S. Geng. 1995. Analysis of the 1987 California Farm Cost Survey and recommendations for future survey. Program on Workable Energy Regulation, University-wide Energy Research Group, University of California.
- Geng, S., K.S. Smallwood, and M. Zhang. 1995. Sustainable agriculture and agricultural sustainability. Proc. 7th International Congress SABRAO, 2nd Industrial Symp. WSAA. Taipei, Taiwan.
- Smallwood, K.S. and S. Geng. 1994. Landscape strategies for biological control and IPM. Pages 454-464 in W. Dehai, ed., Proc. International Conference on Integrated Resource Management for Sustainable Agriculture. Beijing Agricultural University, Beijing, China.
- Smallwood, K.S. and S. Geng. 1993. Alfalfa as wildlife habitat. California Alfalfa Symposium 23:105-8.
- Smallwood, K.S. and S. Geng. 1993. Management of pocket gophers in Sacramento Valley alfalfa. California Alfalfa Symposium 23:86-89.
- Smallwood, K.S. and E.L. Fitzhugh. 1992. The use of track counts for mountain lion population census. Pages 59-67 in C. Braun, ed. Mountain lion-Human Interaction Symposium and Workshop. Colorado Division of Wildlife, Fort Collins.
- Smallwood, K.S. and E.L. Fitzhugh. 1989. Differentiating mountain lion and dog tracks. Pages 58-63 in Smith, R.H., ed. Proc. Third Mountain Lion Workshop. Arizona Game and Fish Department, Phoenix.
- Fitzhugh, E.L. and K.S. Smallwood. 1989. Techniques for monitoring mountain lion population levels. Pages 69-71 in Smith, R.H., ed. Proc. Third Mountain Lion Workshop. Arizona Game and Fish Department, Phoenix.

Fitzhugh, E.L. and K.S. Smallwood. 1987. Methods Manual – A statewide mountain lion population index technique. California Department of Fish and Game, Sacramento.

Salmon, T.P. and K.S. Smallwood. 1989. Final Report – Evaluating exotic vertebrates as pests to California agriculture. California Department of Food and Agriculture, Sacramento.

Smallwood, K.S. and W. A. Erickson (written under supervision of W.E. Howard, R.E. Marsh, and R.J. Laacke). 1990. Environmental exposure and fate of multi-kill strychnine gopher baits. Final Report to USDA Forest Service –NAPIAP, Cooperative Agreement PSW-89-0010CA.

Fitzhugh, E.L., K.S. Smallwood, and R. Gross. 1985. Mountain lion track count, Marin County, 1985.

Unpublished report on file at Wildlife Extension, University of California, Davis.

Posters at Professional Meetings

Smallwood, K.S. and E.L. Fitzhugh. 1989. Differentiating mountain lion and dog tracks. Third Mountain Lion Workshop, Prescott, AZ.

Smith, T. R. and K. S. Smallwood. 2000. Effects of study area size, location, season, and allometry on reported *Sorex* shrew densities. Annual Meeting of the Western Section of The Wildlife Society.

Papers In Review

Smallwood, K.S., M. Zhang, and S. Geng. Landscape effects on pocket gopher density in alfalfa. Geng, S., Yixing Zhou, Minghua Zhang, and K. Shawn Smallwood. A Sustainable Agro-ecological Solution to Water Shortage in North China Plain (Huabei). Environmental Management.

Jones, G., W. D. Sterling, and K. S. Smallwood. A model for spatial scaling effects in ecological density estimation.

Morrison, Michael L., K. Shawn Smallwood, Daniel C. Pearson, Carl G. Thelander, with contributions (in alphabetical order) from H. Resit Akcakaya, Peter A. Bowler, Robert R. Copper, Patrick Foley, Brian Loew, John McCaull, David E. Moser, Richard Redak, and Thomas A. Scott. Role of ecological restoration in habitat conservation plans.

Wilcox, B. A., K. S. Smallwood, and J. R. Kahn. Toward indicators for ecosystem health and natural capital of forest ecosystems. International Conference on Ecosystem Health.

Smallwood, K.S., Conservation Affairs Committee, The Wildlife Society—Western Section. Suggested standards for science applied to conservation issues.

Smallwood, K.S., and S. Anderson. Using a Geographic Positioning System (GPS) to map wildlife and habitat.

Papers in Preparation (Soon to be Submitted)

Smallwood, K.S. The allometry of density within the space used by populations of Mammalian Carnivores.

Smallwood, K.S. Mountain lions in Utopia. Book.

Smallwood, K.S. Estimating prairie dog impacts on the environment.

Smallwood, K.S., and T.R. Smith. Study design and interpretation of Sorex density estimates.

Smallwood, K.S. A biologist's view of CEQA.

Stitt, E. and K. S. Smallwood. Study design and interpretation of Natracine snakes.

Smallwood, K. Shawn, Lourdes Rugge, Stacia Hoover, Michael Morrison, and Carl Thelander. Intra- and inter-turbine string comparison of fatalities to animal burrow densities at Altamont Pass.

Presentations:

Using a Geographic Positioning System (GPS) to map wildlife and habitat. Annual Meeting of the Western Section of The Wildlife Society, Riverside, CA, January, 2000.

Suggested standards for science applied to conservation issues. Annual Meeting of the Western Section of The Wildlife Society, Riverside, CA, January, 2000.

The indicators framework applied to ecological restoration in Yolo County, California. Society for Ecological Restoration, September 25, 1999.

Ecological restoration in the context of animal social units and their habitat areas. Society for Ecological Restoration, September 24, 1999.

Relating Indicators of Ecological Health and Integrity to Assess Risks to Sustainable Agriculture and Native Biota. International Conference on Ecosystem Health, August 16, 1999.

A crosswalk from the Endangered Species Act to the HCP Handbook and real HCPs. Southern California

Edison, Co. and California Energy Commission, March 4-5, 1999.

Mountain lion track counts in California: Implications for Management. Ecological & Environmental Issues Seminar, Department of Biological Sciences, California State University, Sacramento, November 4, 1998.

“No Surprises” -- Lack of science in the HCP process. California Native Plant Society Annual Conservation Conference, The Presidio, San Francisco, September 7, 1997.

In Your Interest. A half hour weekly show aired on Channel 10 Television, Sacramento. In this episode, I served on a panel of experts discussing problems with the implementation of the Endangered Species Act. Aired August 31, 1997.

Spatial scaling of pocket gopher (*Geomys*) density. Southwestern Association of Naturalists 44th Meeting, Fayetteville, Arkansas, April 10, 1997.

Estimating prairie dog and pocket gopher burrow volume. Southwestern Association of Naturalists 44th Meeting, Fayetteville, Arkansas, April 10, 1997.

Ten years of mountain lion track survey. Fifth Mountain Lion Workshop, San Diego, February 27, 1996.

Study and interpretive design effects on mountain lion density estimates. Fifth Mountain Lion Workshop, San Diego, February 27, 1996.

Small animal control. Session moderator and speaker at the California Farm Conference, Sacramento, California, Feb. 28, 1995.

Small animal control. Ecological Farming Conference, Asylomar, California, Jan. 28, 1995.

Habitat associations of the Swainson's Hawk in the Sacramento Valley's agricultural landscape. 1994 Raptor Research Foundation Meeting, Flagstaff, Arizona.

Alfalfa as wildlife habitat. Seed Industry Conference, Woodland, California, May 4, 1994.

Habitats and vertebrate pests: impacts and management. Managing Farmland to Bring Back Game Birds and Wildlife to the Central Valley. Yolo County Resource Conservation District, U.C. Davis, February 19, 1994.

Management of gophers and alfalfa as wildlife habitat. Orland Alfalfa Production Meeting and Sacramento Valley Alfalfa Production Meeting, February 1 and 2, 1994.

Patterns of wildlife movement in a farming landscape. Wildlife and Fisheries Biology Seminar Series: Recent Advances in Wildlife, Fish, and Conservation Biology, U.C. Davis, Dec. 6, 1993.

Alfalfa as wildlife habitat. California Alfalfa Symposium, Fresno, California, Dec. 9, 1993.

Management of pocket gophers in Sacramento Valley alfalfa. California Alfalfa Symposium, Fresno, California, Dec. 8, 1993.

Association analysis of raptors in a farming landscape. Plenary speaker at Raptor Research Foundation Meeting, Charlotte, North Carolina, Nov. 6, 1993.

Landscape strategies for biological control and IPM. Plenary speaker, International Conference on Integrated Resource Management and Sustainable Agriculture, Beijing, China, Sept. 11, 1993.

Landscape Ecology Study of Pocket Gophers in Alfalfa. Alfalfa Field Day, U.C. Davis, July 1993.

Patterns of wildlife movement in a farming landscape. Spatial Data Analysis Colloquium, U.C. Davis, August 6, 1993.

Sound stewardship of wildlife. Veterinary Medicine Seminar: Ethics of Animal Use, U.C. Davis. May 1993.

Landscape ecology study of pocket gophers in alfalfa. Five County Grower's Meeting, Tracy, California. February 1993.

Turbulence and the community organizers: The role of invading species in ordering a turbulent system, and the factors for invasion success. Ecology Graduate Student Association Colloquium, U.C. Davis. May 1990.

Evaluation of exotic vertebrate pests. Fourteenth Vertebrate Pest Conference, Sacramento, California. March 1990.

Analytical methods for predicting success of mammal introductions to North America. The Western Section of the Wildlife Society, Hilo, Hawaii. February 1988.

A state-wide mountain lion track survey. Sacramento County Dept Parks and Recreation. April 1986.

The mountain lion in California. Davis Chapter of the Audubon Society. October 1985.

Ecology Graduate Student Seminars, U.C. Davis, 1985-1990: Social behavior of the mountain lion; Mountain lion control; Political status of the mountain lion in California.

Memberships in Professional Societies:

Western Section of the Wildlife Society
 Association of Southwest Naturalists
 Raptor Research Foundation
 Society for Ecological Restoration

Honors and Awards:

Certificate of Appreciation, The Wildlife Society—Western Section, 2000
 Fulbright Research Fellowship to Indonesia, 1987.
 Northern California Athletic Association Most Valuable Cross Country Runner, 1984.
 National Junior Record, 20 kilometer run, 1982.
 J.G. Boswell Full Academic Scholarship, 1981 (Paid expenses for undergraduate education).

American Legion Award, Corcoran High School, 1981, and John Muir Junior High, 1977.
 CIF Section Champion, Cross Country in 1978 and Track & Field 2 mile run in 1981.
 National Age Group Record, 1500 meter run, 1978.

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