Shawn Smallwood, PhD
3108 Finch Street
Davis, CA 95616

Mike Thomas, Division Chief
U.S. Fish and Wildlife Service
2800 Cottage Way, W-2650
Sacramento, CA 95825-1846

24 April 2017

RE: PG&E Bay Area Operations and Maintenance HCP

Dear Chief Thomas,

I write to comment on the Environmental Assessment (EA) prepared for the proposed Pacific Gas & Electric Company Bay Area Operations and Maintenance Habitat Conservation Plan (HCP) (USFWS 2016a).

My qualifications for preparing expert comments are the following. I earned a Ph.D. degree in Ecology from the University of California at Davis in 1990, where I subsequently worked for four years as a post-graduate researcher in the Department of Agronomy and Range Sciences. My research has been on animal density and distribution, habitat selection, interactions between wildlife and human infrastructure and activities, and conservation of rare and endangered species. I have authored numerous papers on special-status species issues, including "Using the best scientific data for endangered species conservation," published in Environmental Management (Smallwood et al. 1999), and "Suggested standards for science applied to conservation issues" published in the Transactions of the Western Section of The Wildlife Society (Smallwood et al. 2001). I served as Chair of the Conservation Affairs Committee for The Wildlife Society – Western Section. I am a member of The Wildlife Society and the Raptor Research Foundation, and I've been a part-time lecturer at California State University, Sacramento. I served as Associate Editor of wildlife biology's premier scientific journal, The Journal of Wildlife Management, as well as of Biological Conservation, and I was on the Editorial Board of Environmental Management.

I have performed wildlife surveys in California for thirty-two years. I studied the impacts of human activities and human infrastructure on wildlife, including on the impacts of electrocutions on distribution poles and collisions with electric distribution lines and transmission lines and on special-status species including California tiger salamander, California red-legged frog, Salt Marsh harvest mouse, golden eagle, Swainson's hawk, burrowing owl, mountain lion and other species. For 18 years I have studied the impacts of wind energy projects on wildlife, and more recently the impacts of industrial solar projects. I have performed wildlife surveys at many proposed project sites, and I've collaborated with colleagues worldwide on the underlying science and policy issues related to anthropogenic impacts on wildlife. I worked on the Yolo County

HCP in the 1990s and I was involved with other HCPs including Natomas Basin, Headwaters Forest and others. I co-presented at workshops on HCPs at Southern California Edison Company and PG&E.

As a consultant with BioResource Consultants I worked under contract to PG&E on a system to prioritize distribution pole retrofits for reducing electrocution impacts on birds. With a grant from the California Energy Commission's Public Interest Energy Research (PIER), I designed and implemented a largescale study of electrocutions and line strikes involving >9,000 distribution poles and intervening spans in California (BioResource Consultants 2008). I helped supervise another PIER-funded study of the effectiveness of line markers at reducing sandhill crane and other avian impacts caused by distribution line collisions (Yee 2007). I have also assisted with studies directed toward the management of transmission line rights-of-way (ROWs). In summary, I have long been directly and peripherally involved with research on the types of operations and maintenance that are central to the proposed HCP. My CV is attached.

BIOLOGICAL IMPACTS ASSESSMENT

An EIS, rather than the EA, should have been prepared for the proposed HCP. One reason for the EA's insufficiency is the stunningly large spatial magnitude of potential impacts associated with the project. The EA (page 1-1) reports the Plan Area as 402,440 acres, but this acreage was not put into a context so that the reader can readily grasp the magnitude of potential impacts. In fact, 402,440 acres composes 9.1% of the land area of the nine Counties involved (Figure 1). It is one of the largest planning areas proposed for ITP coverage for special-status species (Table 1), but because it is unusually restrictive of the species included for ITP coverage, it's covered species per square mile of planning area averages only 28% of the other HCPs/Conservation Strategies (excluding San Bruno Mountain HCP, which includes 32× more covered species per square mile). Not only was the coverage of special-status species greater amongst the other HCPs and Conservation Strategies within PG&E's planning area, but the levels of environmental review were also generally greater, with 3 based on EIRs and 3 based on EISs (Table 1). Given that an EIS was deemed appropriate for HCPs within PG&E's HCP planning area, it follows that an EIS would be appropriate for PG&E's HCP.

Table 1. Plan Areas of 9 adopted and proposed HCPs within the PG&E HCP Plan Area.

HCP/Strategy	NCCP	Review	Permit term (years)	Plan acres	Covered species
San Bruno Mountain [a]	No	EIR, EA	30 + 30	3,537	3 + 2
East Bay MUD low-effect	No	EAC	30	28,530	7
East Contra Costa County	Yes	EIR, EIS	30	174,018	28
Santa Clara Valley	Yes	EIR, EIS	50	519,506	18
Solano	No	Unknown	30	585,000	37
East Alameda County	No	BO		271,485	19
Alameda Watershed		EIS	30	47,800	18
PG&E	No	EA	30	402,400	18

[a] An addendum to the HCP added 30 years and 2 more covered species to the ITP.

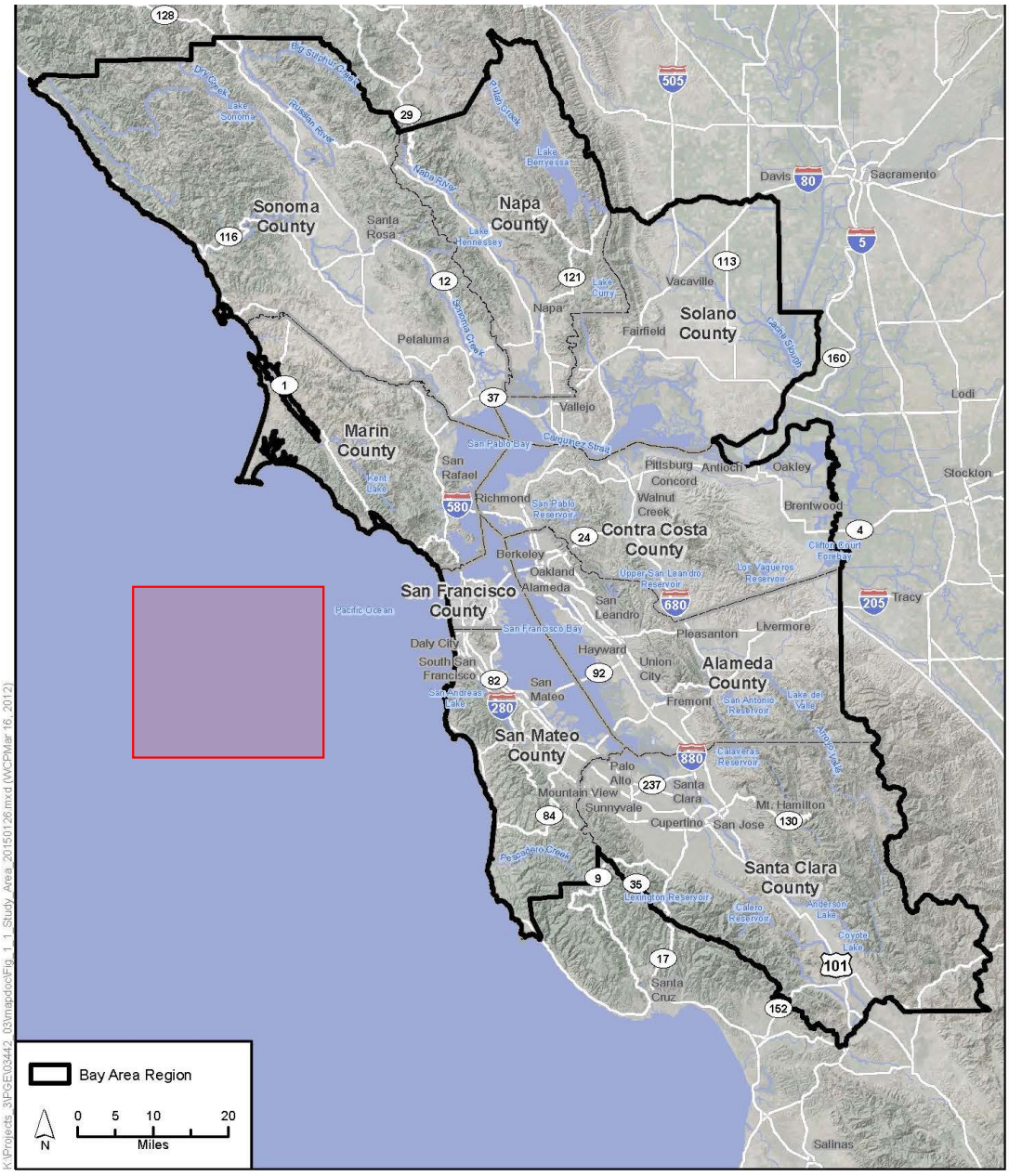


Figure 1. *A modified version of the HCP study area that appeared in the EA's Figure 1-1. In this modified version the red square represents the relative size of the planning area, which composes 9.1% of the land in the study area (black polygon). This square is not tied to a specific location, but rather equals the spatial extent of PG&E's operations and maintenance activities within the study area.*

Wildlife impacts caused by operations and maintenance of electrical distribution and transmission lines and by gas pipelines are many and widespread. I have recorded hundreds of avian electrocutions and line strikes on distribution circuits (Figures 2 through 5). The very first fatality I found in the Altamont Pass Wind Resource Area

(APWRA) was that of a golden eagle electrocuted on a distribution pole (Figure 6). Until many of the poles were retrofit to meet APLIC standards or replaced with underground circuits as wind energy repowering proceeded, scientific monitoring attributed 8% of raptor fatalities to electrocution on distribution poles and 11% to collision with distribution lines (Orloff and Flannery 1992). Given more recent fatality rate estimates (Smallwood 2013), these rates would translate to nearly 300 raptor fatalities per year caused by electric distribution circuits in the APWRA. This fatality rate alone would warrant the preparation of an EIS, and this is only for 4% of PG&E's HCP planning area.

Figure 2. *Great egret killed in Sacramento Valley in December 2006 after colliding with utility lines. Photo by Shawn Smallwood.*

Figure 3. *Distribution line collision victims. Photos by Shawn Smallwood.*

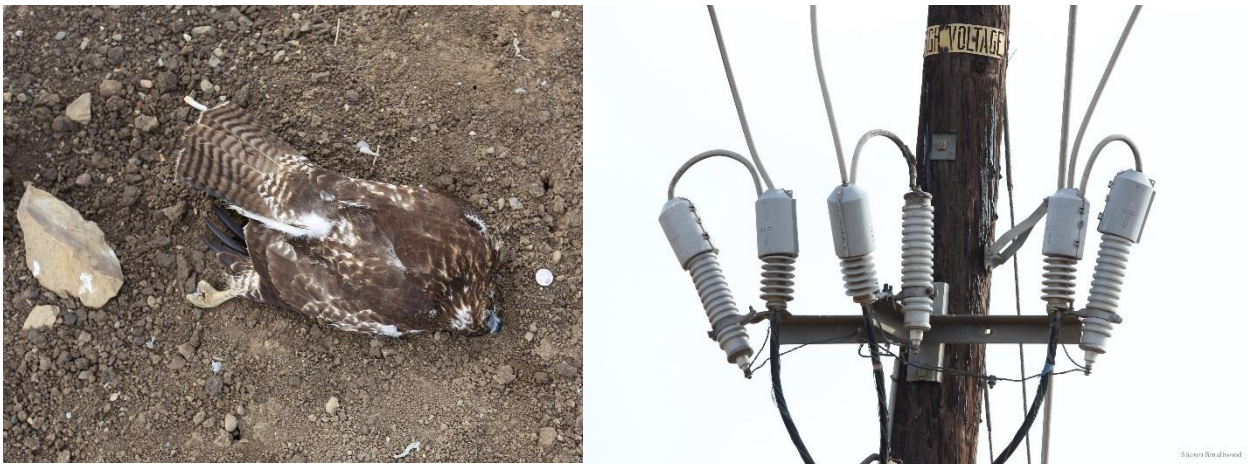


Figure 4. *Red-tailed hawk electrocution under a distribution pole supporting capped riser elements and lightning arrestors, but where one of the caps had not been maintained and fell off, thereby exposing the hawk to electrocution hazard. Photos by Shawn Smallwood.*

Figure 5. *Red-tailed hawk electrocuted on a distribution pole servicing cell towers in Contra Costa County. Photo by Shawn Smallwood.*

Figure 6. *Golden eagle electrocuted on distribution pole in the Altamont Pass Wind Resource Area (APWRA) in 1999. This eagle's electrocution fortunately did not ignite a grassland fire, but in my experience in the APWRA such fires are common enough that I carry either an Indian Fire Pump or fire extinguisher at all times. Photo by Shawn Smallwood.*

During a yearlong study of electrocutions involving 5 visits per 6,375 poles (about 270 miles) in PG&E's service territory, my search crew found 293 electrocuted birds (60 certainly electrocuted and 233 probably electrocuted) and about 523 line strike victims under spans intervening the poles. These numbers of found carcasses translate to 1.09 avian electrocutions per mile and 1.94 avian line collision deaths per mile through 5 searches in the year. Adjusting these finds for the proportion of carcasses not found would generate large estimates of electrocution and line collision mortality, but I have not yet made the adjustments. Based on experience I would guess an adjustment factor of 10 for the carcasses not found due to scavenger removal, searcher error and crippling bias (Smallwood 2007). This adjustment factor applied to the numbers of fatalities found would yield estimates of about 10.9 electrocution and 19.4 line collision fatalities per mile per year. Applying these rates to 23,015 miles of distribution lines in PG&E's HCP planning area (EA page 1-3), I estimate >250,000 electrocution fatalities and >446,000 distribution line collision fatalities annually, or >697,000 annual fatalities caused by distribution lines. Of course, these estimates come with considerable uncertainty due to uncertainty in the proportion of carcasses not found and differences in fatality rates between poles in urban areas versus those on agricultural landscapes and natural areas. But even accounting for these sources of uncertainty and possible bias, the annual fatalities are going to be very large and they include at least 9 special-status species (Appendix 1). An EIS is warranted based on these impact estimates alone.

In another study, Hartman et al. (1992) estimated that 115 kV transmission lines spanning across Mare Island (within PG&E's HCP planning area) annually killed 100 birds per mile over hay fields and 907 birds per mile over wetlands, or 33 and 302 birds per mile of circuit line, respectively. Unfortunately, Hartman et al. (1992) remains the only scientific monitoring effort of which I am aware of transmission line impacts on birds in the western USA. Considering that there are 4,430 miles of transmission lines within PG&E's HCP planning area (EA page 1-3), and extrapolating only the Mare Island hay field fatality rates (to err on the conservative side of estimation), the annual fatality toll caused by avian collisions with existing transmission lines would be about 443,000. This estimate also ignores the likely greater number of circuit lines per mile over most of PG&E's transmission lines in the planning area. Factoring in wetland areas and greater average circuit-line miles per mile than studied at Mare Island, the annual impact of transmission line collisions would easily exceed one million bird deaths per year. Even

ignoring all of the other impacts for the moment, an EIS is warranted for considering transmission line impacts.

The EA (page 1-3) also reports that there are about 207 substations within the planning area. Cyclone fence surrounds these substations for security reasons, and every one of these fences likely poses entanglement risk to birds (Figure 7). I have no empirical foundation for estimating annual fatality rates caused by fencing, but assuming 1 avian fatality per substation per year would total 207 avian fatalities, which is not insignificant.

Figure 7. *A great-horned owl died after becoming entangled on the razor wire placed on top of this cyclone fence surrounding a substation in Alameda County. Photo by Joanne Mount.*

An EIS should be prepared to address all of the impacts to wildlife caused by operations and maintenance of PG&E facilities. Not only do electrocutions directly kill birds landing or perching on distribution poles, and mammals climbing onto poles, but they also start fires often enough that ranchers annually disk firebreaks along distribution circuits to prevent the spread of fires. Herbicides are often applied around poles to prevent vegetative growth from spreading fires to or from the pole -- as some electrocutions result in burning animal carcasses falling from the pole (Figures 8 and 9). Thus, habitat is lost to disked firebreaks, herbicide applications around poles, and fires that spread from burning electrocution victims. Habitat is also lost to maintenance roads accessing transmission towers (Figure 10). All of these impacts need to be addressed in an EIS. Furthermore, the hazards to special-status species due to exposure to herbicide applications around distribution poles needs to be assessed.

Raptors and other birds often perch on distribution poles (Figure 11), which increases their electrocution risk because nest material can combine with the bird's body or carried prey to span phased elements or phased and grounded elements, forming a circuit. Some of these nests are removed to prevent electrocutions and outages, hence the nesting attempt is lost. I have no estimate of the impacts caused by nesting on

distribution poles, but an EIS should include such estimates as part of a more comprehensive environmental review.

Figure 8. *A golden eagle is mobbed by a common raven near distribution lines, which increases the risk of line collision. Note the bare ground around the equipment-bearing pole, which is intended to reduce the risk of fire destroying the pole as well as fire spreading from the pole should electrocuted birds fall to the ground. Note, also, the perch guard installed to discourage birds from perching on the pole. Photo by Shawn Smallwood.*

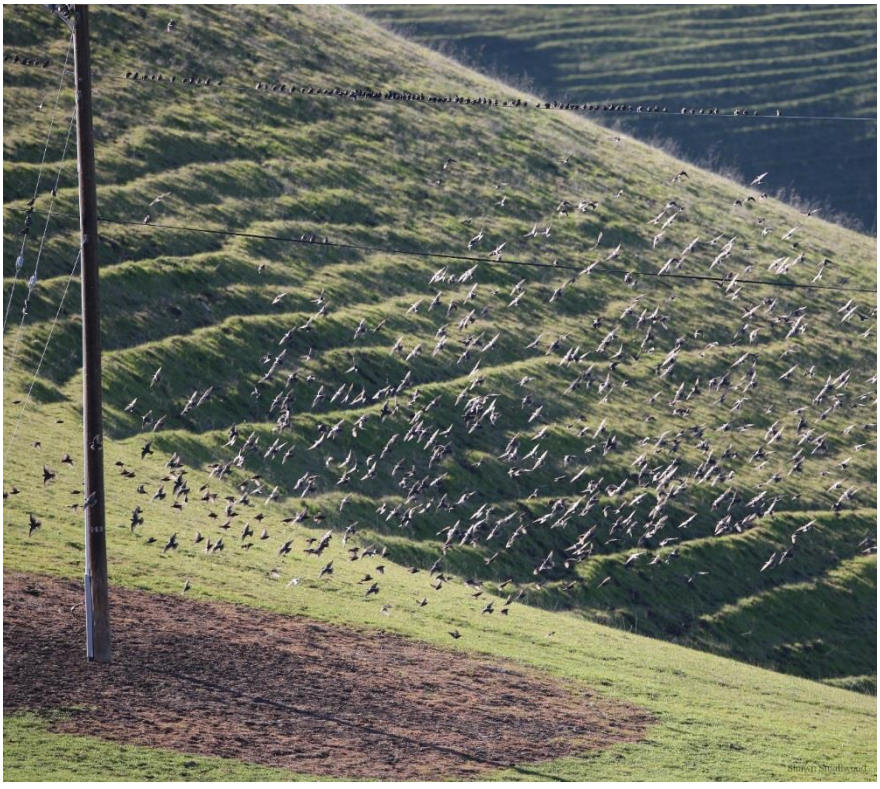


Figure 9. *Mostly European starlings, but some tricolored blackbirds perching close together on distribution lines and flying over ground maintained as bare by use of herbicides. Photo by Shawn Smallwood.*

Figure 10. *Access roads are often graded along transmission line rights-of-way to provide maintenance access to the towers. Photo by Shawn Smallwood.*

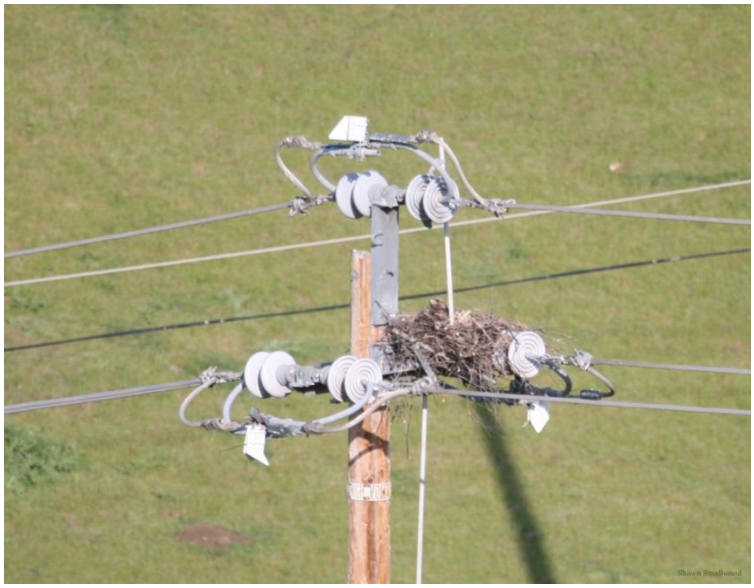


Figure 11. *Red-tailed hawk nests on a distribution pole. Nest material can sometimes form a circuit between phased elements of the pole, thereby endangering the nesting birds. Photo by Shawn Smallwood.*

Transmission lines also pose more complex impacts than injuries and fatalities caused by collisions with existing lines. Existing facilities are sometimes retrofit to increase performance or capacity, and so an EIS is needed to better define where facility modifications qualify as maintenance versus new projects. I recently witnessed the retrofit of existing transmission lines with the addition of ground wires installed above the load-bearing lines. However, although I witnessed the linemen working at the tops of transmission towers, I did not understand what they were doing until I observed a great blue heron appearing to hang dead in mid-air (Figures 12 and 13). The linemen had installed very narrow-gauged ground wires that were nearly invisible from ground positions. Since the retrofit, I have many times seen birds ascend to clear transmission lines and narrowly missing the ground wires suddenly appearing in their "safer" airspace. The death toll from these top wires must be very high.

Figure 12. *A great blue heron hangs from nearly invisible ground wires installed by PG&E above existing transmission lines in 2013. Photo by Shawn Smallwood.*

Figure 13. *Great blue heron (see Fig. 12) hangs from a newly installed ground wire above existing transmission lines. From the ground, this wire was nearly invisible. Another wildlife biologist and I discovered it only after this heron marked it for us. Photo by Shawn Smallwood.*

Another type of impact caused by distribution and transmission lines is the energetic cost of birds and bats attempting to avoid colliding with the lines (Figures 14 and 15). Figure 14 depicts a near-miss maneuver that must come with considerable energy cost and the risk of injury without even colliding with a line. Figure 15 depicts the energetic cost of having to gain altitude to clear the lines before reaching a destination on the other side. Although not yet quantified, I have observed hundreds of near-miss collisions during diurnal behavior surveys of raptors encountering transmission and

distribution lines in Alameda and Contra Costa Counties, and using a thermal imaging camera I have recorded hundreds of near misses during nocturnal surveys of owls and bats. I also witnessed a duck's fatal collision with a distribution line as the duck was flying at high speed with a strong wind. Evasive maneuvers have been quantified for sandhill cranes and waterfowl crossing distribution lines in California (Yee 2007) and for many types of birds crossing transmission lines (Hartman et al. 1992). These maneuvers cost energy that birds and bats otherwise would direct toward migration, local movements, foraging, predator avoidance, and reproduction. They are impacts, and these impacts should be assessed more comprehensively in an EIS.

Figure 14. *A golden eagle narrowly avoids colliding with electric distribution lines in Contra Costa County. Coincidentally, this eagle happened to be one tracked by Dr. Douglas Bell, myself and others – the CTT telemetry unit is visible on the eagle's back. Photo by Shawn Smallwood.*

Figure 15. *White-faced ibises flap hard to ascend to avoid colliding with distribution lines before descending into the adjacent field for foraging. Photo by Shawn Smallwood.*

Covered Species

For a project area encompassing nine Counties with an exceptional diversity of ecological communities, the list of species proposed for coverage under an incidental take permit (ITP) is obviously too short. HCPs typically cover species anticipated to be listed as threatened or endangered during the life of the ITP. Species covered in California HCPs or NCCPs typically include those listed or proposed for listing as threatened or endangered under FESA or CESA, species of special concern in California, and species that are candidates for listing under California Fish and Wildlife Code. There are multiple species likely to require listing protections that are not proposed for ITP coverage and not assessed in this EA.

Seven species of terrestrial vertebrates have been proposed for coverage under the ITP sought by PG&E. California tiger salamander has been covered or proposed for coverage in five other HCPs either approved or in planning within the PG&E project area, and California red-legged frog has been covered or proposed for coverage in six other HCPs (Table 2). These two species make perfect sense for coverage under the proposed ITP. The other proposed covered species are also covered by ITPs in other HCPs within the project area, and so they also make sense. However, other HCPs within the PG&E project area have covered or proposed to cover numerous special-status species that are not proposed for coverage under the PG&E plan.

Foothill yellow-legged frog was covered under ITPs in four HCPs within the PG&E project area, but not by the PG&E plan (Table 2). The species is listed as a California species of concern because it has been declining. It should be covered by the proposed ITP sought by PG&E. The project's potential impacts should be assessed and a mitigation plan formulated in an EIS.

Western spadefoot is covered by the ITP issued for the Santa Clara Valley HCP, but not by the PG&E plan (Table 2). Because it has been declining, this species is a candidate for listing under the federal ESA and is listed as a California species of concern. It should be covered by the proposed ITP sought by PG&E. Some breeding locations likely occur in low-lying portions of landscapes, which is also where PG&E would have routed gas pipelines. The project's potential impacts should be assessed and a mitigation plan formulated in an EIS.

Silvery legless lizard is covered by the ITP issued for the East Contra Costa County HCP, but is not covered by the ITP sought for PG&E's HCP (Table 2).

Two other HCPs in the project area cover giant garter snake, which is not proposed for coverage in the PG&E plan (Table 2). That portion of the PG&E project area extending east onto the floor of the Great Central Valley potentially supports giant garter snakes. The project's potential impacts on giant garter snake should be assessed and a mitigation plan formulated in an EIS.

Even though four other HCPs in the PG&E project area thought it prudent to cover western pond turtle, the PG&E HCP does not (Table 2). The geographic range of western pond turtles has declined greatly, but this species occurs throughout PG&E's HCP planning area (Buskirk 2002). Western pond turtles breed in upland areas, sometimes traveling overland 5 km and farther from stream refugia. Pond turtles traveling to or from breeding sites are vulnerable to crushing by vehicles transporting maintenance crews along facility rights-of-way. Western pond turtles also could be adversely affected by 3,768 acres of "minor new construction," 3.014 acres of which are on natural lands. This construction would alone qualify as a major loss of habitat, and its impacts should be assessed in an EIS.

The Solano County HCP covers California black rail (Table 2), which along with Ridgeway rails I detected during call-back surveys at Military Ocean Terminal, Concord (MOTCO). California black rail is spread throughout the dense marshes of the Suisun

Straight and San Pablo Bay, within the PG&E planning area, but the species has been declining (Evens et al. 1991, Spautz et al. 2005). Ridgeway rail has similarly been declining, and occurs extensively within the PG&E planning area (Harvey 1988, Eddleman and Conway 1998). I wonder why Ridgeway rail but not black rail is proposed for coverage in PG&E's HCP.

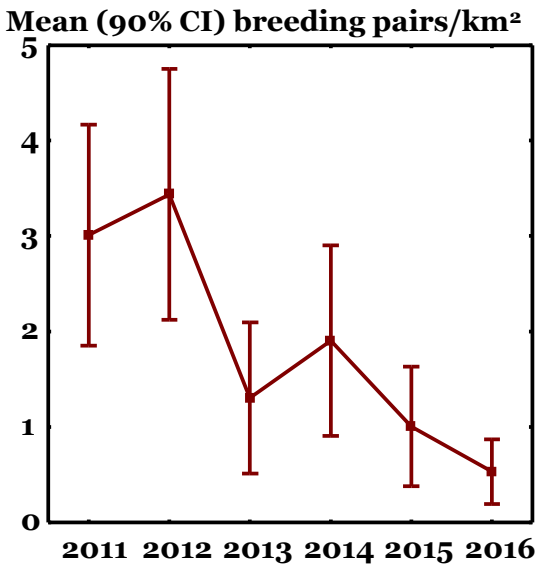
Golden eagle is covered by two other HCPs in PG&E's HCP planning area, but is not proposed for coverage in PG&E's HCP (Table 2). Golden eagles are expected to decline 35% in number across the USA due to anthropogenic sources of mortality including wind power development and electrocutions on distribution poles (USFWS 2016b). PG&E's operations and maintenance are integral to this substantial, cumulative impact of wind energy development because it provides the transmission infrastructure needed to deliver wind energy to load demand. Furthermore, the retrofitting of electric distribution poles to meet Avian-Powerline Interaction Committee (APLIC) standards for avian safety is proposed as the sole mitigation measure for offsetting the take of golden eagles by wind turbines. Any golden eagles inadvertently killed by electrocution or line collision on PG&E infra-structure will negate some portion of the benefits accrued through wind energy mitigation. And that golden eagles are killed by this infra-structure was evident in the 179 eagles tracked by radio-telemetry, nearly 30% o fwhich were killed by electrocution or distribution line strike (Hunt 2002). Habitat loss caused by "minor new construction" will also negate benefits accrued through wind energy mitigation. Even not considering wind energy mitigation, golden eagles adversely affected by PG&E operations and maintenance would be significant, and most especially cumulatively significant in the face of the U.S. Fish and Wildlife Service's prediction of a devastating reduction of golden eagles nationwide (USFWS 2016b).

Swainson's hawk is prudently covered by two other HCPs in PG&E's planning area, but not it is not proposed for coverage in PG&E's HCP (Table 2). Swainson's hawks have declined substantially in California (Bloom 1980). The decline will likely continue as urban sprawl takes more habitat (England et al. 1995), and it can greatly accelerate as grasslands are converted to vineyards (Swolgaard et al. 2008) or market forces decrease the production acreage of alfalfa hay or rice cultivation in our region (Bechard 1982, Estep 1989, 2008; Babcock 1995, Smallwood 1995, Smallwood and Geng 1993a,b). I should also note that, despite the overall decline of the species in California, and despite the species' dependence on an unstable resource base (alfalfa and a few other crops), the range of Swainson's hawk recently increased within the PG&E HCP planning area. Last year I documented Swainson's hawks breeding in the Altamont Pass for the first time, although I photographed a juvenile in the Altamont Pass in 2013. I learned from colleagues that Swainson's hawks also likely nested in the Santa Clara Valley last year. Given the species' occurrence within the PG&E HCP planning area, and given the overall decline of the species, its listing as threatened under CESA, and its likely federal listing within the next 30 years, Swainson's hawk ought to be included on the list of HCP covered species and an impacts assessment provided in an EIS.

Burrowing owl is understandably covered by five other HCPs in PG&E's project area, but is not proposed for coverage under PG&E's HCP (Table 2). Burrowing owls have been declining in California. In the APWRA, where wind turbines had been killing about 600

burrowing owls per year (Smallwood et al. 2007), the species has declined about 85% between 2011 and 2016 (Figure 16) (Smallwood et al. 2013; Smallwood, unpublished data 2017). I have documented similar declines elsewhere in the species' range within California. This past February I was invited as an expert to present at a workshop on burrowing owl conservation, which was funded by the Santa Clara Valley HCP. This workshop addressed the increasingly dire situation in Santa Clara County where the known adult population has declined to 61 burrowing owls. Near-term extirpation is a real possibility across major portions of the species' range within PG&E's HCP planning area.

Figure 16. *Mean burrowing owl breeding pair density declined since 2011 amongst 46 randomly sampled plots throughout the Altamont Pass Wind Resource Area in Alameda and Contra Costa Counties, all within PG&E's HCP planning area. Smallwood, unpublished data.*



PG&E's operation and maintenance activities risk injury, death and displacement impacts to burrowing owls. Burrowing owls are vulnerable to electrocution on distribution poles and collisions with lines (Appendices 1 and 2). They are also vulnerable to displacement caused by inspections and maintenance activities along transmission lines and gas pipelines. Just recently, on 13 April 2017, I was surveying for burrowing owls in the Altamont Pass when the last two breeding pairs I had found that day were flushed by a caravan of PG&E trucks and a tractor driving over wet grassland during a rainstorm, moving from one set of transmission towers to the next. The PG&E crew appeared oblivious to the owls as they drove within about 3 feet of both nest burrows, flushing the owls to the other side of the canyon. Not only did this caravan narrowly miss driving over the owls' nest burrows, but their flushing of the owls exposed the owls to predators. These types of potential impacts to a declining species – one that is likely to be listed as threatened or endangered in the near future – warrant inclusion of the species as a covered species a comprehensive assessment in an EIS.

Tricolored blackbird is understandably covered by five other HCPs in PG&E's planning area, but is not proposed for coverage under PG&E's HCP (Table 2). Tricolored blackbirds nest throughout the low-lying portions of Solano, Alameda and Contra Costa Counties, including throughout the Altamont Pass Wind Resource Area. Tricolored blackbirds are particularly vulnerable to line collisions, and to electrocution when

aggregating on powerlines and distribution poles and multiple individuals touch each other to form a circuit between two phased elements or between phased and grounded elements. Nesting can also be disrupted by travel along rights-of-way and by trenching along pipelines. In the APWRA I often find breeding populations of tricolored blackbird along canyon and valley bottoms where natural gas pipelines have been routed. This species should be included on the covered species list and potential project impacts assessed in an EIS.

Least Bell's vireo is covered by the ITP issued for the Santa Clara Valley HCP, but it is not proposed for coverage under PG&E's HCP (Table 2). On 12 June 2001, I detected a breeding pair of least Bell's vireo at 36.83 N, 121.62 W (Decimal Degrees), only 8 km from the southern boundary of the planning area. The species has also been detected farther north, within the project area boundary at various times (ICF 2016). This species should be included on the covered species list and potential project impacts assessed in an EIS.

Townsend's western big-eared bat, pallid bat, and American badger are each covered by ITPs issued for other HCPs in PG&E's planning area, but are not proposed for coverage under PG&E's HCP (Table 2). Multiple operations and maintenance activities could adversely affect these species, which undoubtedly occur in the HCP planning area. Over the next 30 years there is the strong possibility that all three of these species could be listed due to the effects of cumulative impacts caused by wind turbines (to bats), ground squirrel control and auto collisions (to badgers), PG&E's proposed "minor new construction," and the operations and maintenance of facilities along linear rights-of-way. These species should be included on the covered species list and potential project impacts assessed in an EIS.

Forty-eight species and sub-species not covered by local HCPs include the following: Coast horned lizard, San Joaquin coachwhip, American white pelican, least bittern, White-faced ibis, western snowy plover, Mountain plover, greater sandhill crane, lesser sandhill crane, Barrow's goldeneye, Tule greater white-fronted goose, California gull, California least tern, marbled murrelet, California condor, bald eagle, Ferruginous hawk, northern harrier, white-tailed kite, Prairie falcon, peregrine falcon, long-eared owl, short-eared owl, Northern spotted owl, Black swift, Vaux's swift, purple martin, bank swallow, Olive-sided flycatcher, Yellow-billed magpie, loggerhead shrike, yellow warbler, Yellow-breasted chat, San Francisco common yellowthroat, Modesto song sparrow, Oregon vesper sparrow, Grasshopper sparrow, Bryant's savannah sparrow, Suisun song sparrow, Samuels song sparrow, Alameda song sparrow, yellow-headed blackbird, Suisun shrew, Salt marsh wandering shrew, Western red bat, Western yellow bat, Western mastiff bat, and San Francisco dusky-footed woodrat (Table 2). Many if not all of these species will likely become imperiled and will need listing as threatened or endangered sometime during the 30 year period of the ITP, partly due to PG&E's operations and maintenance of facilities.

Among the species listed in the preceding paragraph and in Table 2 are a few that some biologists might dispute. California condor, for example, is not known to occur within

the project area. However, according to eBird (http://ebird.org/ebird/explore) data, California condor has been photo-documented in Santa Clara County, within the HCP area. This species has been expanding northward since its reintroduction to the wild from captive breeding. PG&E's HCP ought to anticipate potential impacts to condors, which are prone to line collisions and electrocutions.

Bald eagle is another species some biologists would likely question as a candidate for inclusion on an ITP. However, bald eagles occur in the project area, and I discovered one killed by a wind turbine in the Altamont Pass Wind Resource Area. Takings of bald eagles by wind turbines will require permitting under the new USFWS eagle take rule, and takings will need to be mitigated by power pole retrofits per the USFWS take rule. Any bald eagles inadvertently killed by electrocution or line collision on PG&E infra-structure will negate some portion of the benefits accrued through wind energy mitigation.

Yellow-billed magpie is another species some biologists would likely question as a candidate for inclusion on an ITP. However, in January 2017 the US Fish and Wildlife Service listed it as a Bird of Conservation Concern. I have been monitoring the species in the Sacramento Valley since 1989, and since 2005 yellow-billed magpies declined >90% due to the emergence of West Nile Virus (Smallwood and Nakamoto 2009, Smallwood unpublished data through 2016). Given the ongoing trend in numbers and distribution, I foresee the need to list the Yellow-billed magpie as threatened in the very near future (in my assessment, it should be listed already). The species occurs within the HCP planning area and it is vulnerable to electrocution and line strikes (Appendices 1 and 2), so therefore it should be included on the covered species list and potential project impacts assessed in an EIS.

Marbled murrelet, a threatened species under FESA and endangered species under CESA, occurs within Sonoma, Marin, and San Mateo Counties – within PG&E's HCP planning area -- and has been declining (USFWS 2009), but it is not on the proposed list of covered species. This species flies to and from ocean foraging areas from mostly old-growth forest stands, flying fast at tree-top height during late evening and early morning hours. Any transmission lines or distribution lines located between coastal waters and old-growth stands pose risk of collision mortality to marbled murrelet. This species should be included on the covered species list and potential project impacts assessed in an EIS.

The southern-most population of northern spotted owls breeds in Sonoma and Marin Counties, within PG&E's HCP planning area (Evens 2016). The species is declining (Duggar et al. 2016). Operations and maintenance activities, and "minor new construction," within nesting or foraging habitat of northern spotted owl could cause significant impacts to the species. This species should be included on the covered species list and potential project impacts assessed in an EIS.

Greater and lesser sandhill cranes occur within &E's HCP planning area. My fatality search crew found them as distribution line fatalities (Appendix 1), and fatality searchers in the APWRA have found at least one killed by a wind turbine. I often hear

sandhill cranes flying over the APWRA at night. Multiple distribution line collisions prompted a study of line markers on PG&E distribution lines in an effort to reduce fatalities (Yee 2007), a study with which PG&E kindly facilitated by installing markers and providing access for fatality searching. Anyhow, transmission lines and distribution lines are known major threats to sandhill cranes. That they are not included as covered species under PG&E's HCP is surprising. These species should be included on the covered species list and potential project impacts assessed in an EIS.

Summary of Covered Species Issues

Whereas only 7 species of terrestrial vertebrates are proposed for coverage under the HCP's ITP, I see the need for coverage of 69 special-status species (Table 2). Given the extent of the planning area, which is an extensive network of distribution lines, transmission lines, natural gas pipelines, substations and other facilities occupying 9.1% of the land area of nine California Counties, it is incredible that the proposed HCP covers only 7 terrestrial vertebrate species. My list makes much more sense, especially considering the nature and magnitudes of the potential impacts. Seven species are already listed as threatened or endangered under FESA but are not included on the covered species list, including giant garter snake, western snowy plover, California least tern, marbled murrelet, California condor, northern spotted owl, and least Bell's vireo. These are the easiest species to justify for inclusion. The two species of eagle are protected by a federal law dedicated to these species, so they are also easily justifiable for inclusion. Then there are 4 species listed as threatened or endangered under CESA but are not included on the covered species list, including greater sandhill crane, Swainson's hawk, bank swallow and tricolored blackbird. These species are also easy to justify for inclusion on the covered species list. Many of the other species have yet to be listed as threatened or endangered, possibly due to politics rather than science, but there is ample reason to believe they will be listed sometime during the next 30 years. After all, California tiger salamander was only a candidate for listing only 18 years ago. Two recently listed species had to be added to the San Bruno Mountain HCP in an addendum. The status of species change fast; HCP's with long take permit periods should be prepared for impacts to all species reasonably likely to require protection during the permit period.

The 69 terrestrial vertebrate species I listed in Table 2 also serve to highlight both the ecological diversity of the Bay Area and the growing levels of threats to the ecosystem. The types and magnitudes of impacts from operation and maintenance of PG&E facilities are complex; they are sufficiently complex to warrant a more comprehensive impacts assessment in an EIS.

***Table 2**. Occurrence likelihoods of wildlife species in the project area, and take permit coverage or proposed coverage per HCP, where SCV = Santa Clara Valley, ECC = East Contra Costa County, AW = Alameda Watershed, EAC = East Alameda County, EBM = East Bay MUD Low Impact, SBM = San Bruno Mountain, SOL = Solano County, and PG&E = Pacific Gas & Electric HCP.*

Common name, *Species name*	**Status**	**Covered by Take Permit?**							
		SCV	**ECC**	**AW**	**EAC**	**EBM**	**SBM**	**SOL**	**PG&E**
California tiger salamander, *Ambystoma californiense*	FT, FE (Sonoma), CT	Yes	Yes	Yes	Yes			Yes	Yes
California red-legged frog, *Rana draytonii*	FT, CSC	Yes	Yes	Yes	Yes	Yes		Yes	Yes
Foothill yellow-legged frog, *Rana boylii*	CSC	Yes	Yes	Yes	Yes				
Western spadefoot, *Scaphiopus hammondii*	FC, CSC	Yes							
Coast horned lizard, *Phrynosoma blainvillii*	CSC								
Silvery legless lizard, *Anniella pulchra pulchra*	CSC		Yes						
San Joaquin coachwhip, *Masticophis flagellum ruddocki*	CSC								
Alameda whipsnake, *Masticophis lateralis euryxanthus*	FT, CT		Yes	Yes	Yes	Yes			Yes
Giant garter snake, *Thamnophis gigas*	FT		Yes					Yes	
San Francisco garter snake, *Thamnophis sirtalis tetrataenia*	FE, CFP						Yes		Yes
Western pond turtle, *Emys marmorata*	CSC	Yes	Yes	Yes		Yes			
American white pelican, *Pelecanus erythrorhynchos*	SSC1								
Least bittern, *Ixobrychus exilis*	SSC2								
White-faced ibis, *Plegadis chihi*	FSC, TWL								
Greater sandhill crane, *Grus canadensis tabida*	CT, CFP								
Lesser sandhill crane, *Grus c. canadensis*	SSC3								
Western snowy plover, *Charadrius alexandrines nivosus*	FT, SSC								
Mountain plover, *Charadrius montanus*	FSC, SSC2								
Tule greater white-fronted goose, *Anser albifrons elgasi*	SSC3								
Barrow's goldeneye, *Bucephala islandica*	SSC								
Ridgeway rail, *Rallus obsoletus*	FE, CFP							Yes	Yes
California black rail, *Laterallus jamaicensis coterniculus*	BCC, CT							Yes	

Common name, *Species name*	Status	Covered by Take Permit?							
		SCV	**ECC**	**AW**	**EAC**	**EBM**	**SBM**	**SOL**	**PG&E**
California gull, *Larus californicus*	TWL								
California least tern, *Sternula antillarum browni*	FE, CE								
Marbled murrelet, *Brachyramphus marmoratus*	FT, CE								
California condor, *Gymnogyps californianus*	FE, CE								
Bald eagle, *Haliaeetus leucocephalus*	BGEPA, BCC, CE								
Golden eagle, *Aquila chrysaetos*	BGEPA, BCC, CFP		Yes		Yes				
Swainson's hawk, *Buteo swainsoni*	BCC, CT		Yes					Yes	
Ferruginous hawk, *Buteo regalis*	BCC, TWL								
Northern harrier, *Circus cyaneus*	SSC3								
White-tailed kite, *Elanus leucurus*	FSC, CFP								
Prairie falcon, *Falco mexicanus*	BCC, TWL								
Peregrine falcon, *Falco peregrinus*	BCC, CFP								
Long-eared owl, *Asio otus*	SSC3								
Short-eared owl, *Asio flammeus*	SSC3								
Burrowing owl, *Athene cunicularia*	BCC, SSC2	Yes	Yes	Yes	Yes			Yes	
Northern spotted owl, *Strix occidentalis caurina*	FT, CT								
Black swift, *Cypseloides niger*	SSC3								
Vaux's swift, *Chaetura vauxi*	SSC2								
Purple martin, *Progne subis*	SSC2								
Bank swallow, *Riparia riparia*	CT								
Olive-sided flycatcher, *Contopus cooperi*	SSC2								
Yellow-billed magpie, *Pica nuttalli*	BCC								
Loggerhead shrike, *Lanius ludovicianus*	FSC, SSC2								
Least Bell's vireo, *Vireo bellii pusillus*	FE, CE	Yes							
Yellow warbler, *Setophaga petechia*	SSC2								
San Francisco common yellowthroat, *Geothlypis trichas sinuosa*	SSC3								
Yellow-breasted chat, *Icteria virens*	SSC3								
Oregon vesper sparrow, *Pooecetes gramineus affinis*	SSC2								
Bryant's savannah sparrow, *Passerculus sandwichensis alaudinus*	SSC3								

Common name, *Species name*	Status	Covered by Take Permit?							
		SCV	**ECC**	**AW**	**EAC**	**EBM**	**SBM**	**SOL**	**PG&E**
Grasshopper sparrow, *Ammodramus savannarum*	SSC2								
Modesto song sparrow, *Melospiza melodia malliardi*	SSC3								
Suisun song sparrow, *Melospiza melodia maxillaris*	SSC3								
Samuels song sparrow, *Melospiza melodia samuelis*	SSC3								
Alameda song sparrow, *Melospiza melodia pusillula*	SSC2								
Tricolored blackbird, *Agelaius tricolor*	BCC, Cand. CE, SSC1	Yes	Yes	Yes	Yes			Yes	
Yellow-headed blackbird, *Xanthocephalus xanthocephalus*	SSC3								
Suisun shrew, *Sorex ornatus sinuosus*	CSC								
Salt marsh wandering shrew, *Sorex vagrans halicoetes*	CSC								
Pallid bat, *Antrozous pallidus*	CSC					Yes			
Townsend's western big-eared bat, *Plecotus t. townsendii*	CSC		Yes	Yes					
Western red bat, *Lasiurus blossevillii*	CSC								
Western yellow bat, *Lasiurus xanthinus*	CSC								
Western mastiff bat, *Eumops perotis*	CSC								
Salt marsh harvest mouse, *Reithrodontomys raviventris*	FE, CFP							Yes	Yes
San Francisco dusky-footed woodrat, *Neotoma fuscipes annectens*	CSC								
San Joaquin kit fox, *Vulpes macrotis mutica*	FE, CT	Yes	Yes		Yes				Yes
American badger, *Taxidea taxus*	CSC				Yes				

[1] Listed as FE = federal endangered, FCC = U.S. Fish and Wildlife Service Bird of Conservation Concern, CE = California endangered, SSC = California species of special concern (not threatened with extinction, but rare, very restricted in range, declining throughout range, peripheral portion of species' range, associated with habitat that is declining in extent), CFP = California Fully Protected (CDFW Code 4700), CDFW 3503.5 = California Department of Fish and Wildlife Code 3503.5 (Birds of prey), and SSC1, SSC2 and SSC3 = California Bird Species of Special Concern priorities 1, 2 and 3, respectively (Shuford and Gardali 2008), and TWL = Taxa to Watch List (Shuford and Gardali 2008), WBWG = Western Bat Working Group listing as moderate or high priority.

[2] Observed by consultants contributing to DEIR.

[3] Recorded on site or nearby in eBird (http://ebird.org/ebird/explore).

[5] Recorded on site by Ulsan.

Minor New Construction

The EA (page 1-10) listed minor new construction as a plan component. When I first looked over the plan components I did not pay much attention to the 3,768 acres of minor new construction, probably because the other acreage totals associated with existing facilities were so large. However, I eventually realized how large an area this minor new construction would take – an area that serves as wildlife habitat. In fact, 3,014 of these acres are characterized as natural land covers. Land conversions totaling nearly six square miles would alone warrant an HCP. After all, the area of the San Bruno Mountain HCP was smaller.

An EIS should be prepared to assess impacts caused by habitat loss to new construction. The EIS should include map locations and boundaries of anticipated new construction so that the impacts can be assessed. As the EA stands, 3,768 acres of habitat destruction could occur anywhere in the nine county planning area. But some places are more sensitive than others, and so the public should be informed about where and how PG&E intends to construct new facilities.

Covered Activities

According to the EA (page 2-2), covered activities would not include application of herbicides, rodenticides, or fungicides. This exclusion concerns me because herbicides are applied to vegetation surrounding many distribution poles. Rodenticides can threaten multiple special-status species, especially if rodenticides are directed to ground squirrels, pocket gophers or other fossorial species that are of critical ecological importance to many special-status species. Why are herbicides, rodenticides, and fungicides excluded as covered activities? Are they to be regulated separately?

Habitat Models

Instead of relying on scientific inventory and monitoring to assess potential impacts to wildlife, the HCP intends to rely on habitat models (EA page 2-11). The EA refers to commercial data and biological information as the bases for the models, but otherwise there is little explanation of the models. The public is uninformed about the commercial data allegedly used, although a paragraph on Model Updates refers to continuing to subscribe to California's Natural Diversity Data Base (more on CNDDB below). We are uninformed about the biological information that is to be used. Other than a passing reference to GIS, the public is given no information about how the input data will be managed or analyzed. There is no model structure presented, and no presentation of underlying assumptions. In short, the EA presents habitat models as a black box. An EIS needs to be prepared for this HCP, and the EIS needs to describe, in detail, the models PG&E intends to use, including all data sources, assumptions, potential biases and sources of uncertainty.

According to the EA, PG&E will update its habitat models by continuing to subscribe to CNDDB. This assurance implies that CNDDB is a data source for the habitat models. If this is true, then the habitat models are fundamentally flawed. CNDDB relies on

voluntary reporting by biologists who were fortunate enough to gain access to properties and who go through the trouble of reporting what they found to CNDDB. CNDDB is not based on scientific sampling or equal access to properties. The limitations of CNDDB are well-known, and they are summarized in a warning presented by CDFW on the CNDDB web site (https://www.wildlife.ca.gov/Data/CNDDB/About): "*We work very hard to keep the CNDDB and the Spotted Owl Database as current and up-to-date as possible given our capabilities and resources. However, we cannot and do not portray the CNDDB as an exhaustive and comprehensive inventory of all rare species and natural communities statewide. Field verification for the presence or absence of sensitive species will always be an important obligation of our customers…*" PG&E's input of CNDDB data misinforms its habitat models, which look to me as if they will be used to determine species presence/absence in place of protocol-level detection surveys. This approach is fundamentally flawed and will result in false predictions of absence.

The EA's references to Map Book zones and Hot Zones are defined, but the definitions conflict with longstanding principles of wildlife ecology. A Hot Zone is defined as "*an area containing a known localized population of covered wildlife species with a small and well-defined range where the species would most likely be affected should Covered Activities be implemented"* (page 2-12). One problem with this definition, as alluded to in the preceding paragraph, is the application of Hot Zones to those places where appropriate surveys have been performed and where biologists know the species occurs. But what about the places where surveys have not been performed and where neither CNDDB nor field biologists are aware that the species is present in abundance. A good example of this misapplication of Hot Zones would be burrowing owls in the Altamont Pass Wind Resource Area. Statewide surveys of burrowing owls based on many randomly selected sampling plots completely missed recording any burrowing owls in the APWRA because no sampling plots were accessible on private property in the A{PWRA, so no surveys were done there (DeSante et al. 1996, 2007). As it turns out, the breeding population was estimated at 537 pairs in 2011 (Smallwood et al. 2013), so one of California's significant burrowing owl populations had gone undocumented for many years due to lack of access to private property.

Related to the problem above, wildlife ecologists typically select sites for study of a species where they already know the species to be abundant (Smallwood and Schonewald 1996). Investigators typically have a limited budget, so rather than wasting their research money on the gamble of a random site, they select a known high-density site. This is why we always see density estimates as an inverse power function of the study area size used to derive the density estimates (Figure 17, using burrowing owl as an example). Assuming for the moment that PG&E would map burrowing owl Hot Zones, in Figure 17 the mapped Hot Zones might be those sites associated with the data points on the left side of the graph. But if one were to increase the area studied, then Figure 17 informs us that increasingly more high-activity areas would be found while the overall density decreases. Another way of looking at the data can be viewed in Figure 18, switching from burrowing owls to northern spotted owls as our example. In Figure 18 the Hot Zones concept evaporates; after all, which of the data points would represent the Hot Zones? A third way of examining these data is presented in Smallwood (1999, 2001), where non-log transformed estimates of abundance are plotted on study area size

to identify where abundance stops increasing with study area size and fails to change again through a range of increasing study area sizes. This last data examination requires a bit more care in working with the scale of the scatterplot's X and Y axes, but it can yield the ranges of areas in which meaningful demographic units occur. This approach would be useful for assessing the numerical capacity of habitat areas and the demographic meaning of project impacts.

Figure 17. *Breeding pair density of burrowing owls declines as an inverse power function of increasing study area size among published estimates from throughout the species' geographic range, and where dashed lines connect density estimates derived from sampling plots that were projected to larger study areas (large circles). The regression slope was estimated only from sampled study areas (small circles). (Smallwood unpublished data).*

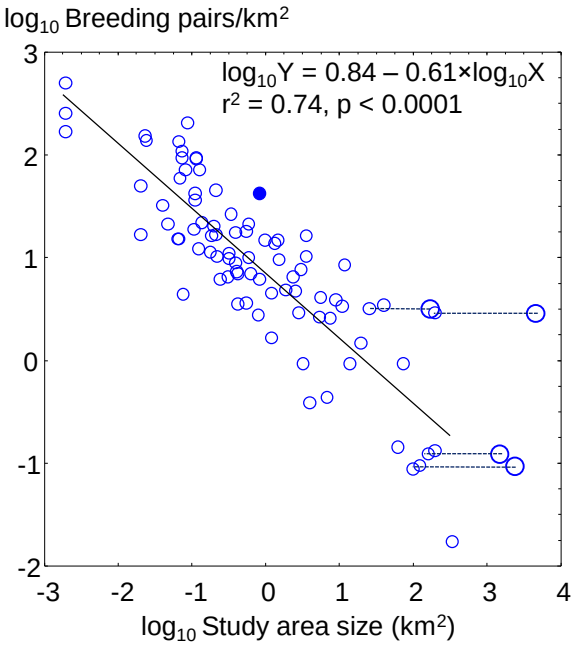
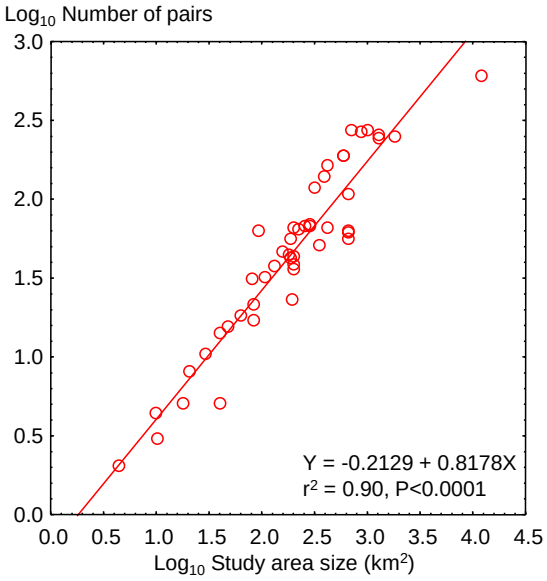


Figure 18. *Breeding pair density of northern spotted owls increases as a power function of increasing study area size among published estimates from throughout the species' geographic range. (Smallwood unpublished data).*



Another problem with the Hot Zone definition is that those terrestrial vertebrate species studied long enough and over large enough areas demonstrate a shifting mosaic pattern of abundance (Taylor and Taylor 1979, den Boer 1981). Let's take the burrowing owl as

an example. Figure 19 shows the distribution of sampling plots across the Altamont Pass Wind Resource Area and their relative densities of breeding pairs in 2011. The first complication with the Hot Spots definition is found when mapping out the distributions of burrowing owls during the non-breeding seasons (Figure 20). And then it turns out that the breeding season densities among plots in 2011 were predictive of the breeding season densities in 2012, but they were increasingly less predictive with each successive year (Figure 21). Within five years, the hot spots observed in 2011 became cold spots, whereas the hot spots in 2016 were in entirely new locations (Figure 21). The hypothesized reasons for this shifting mosaic pattern of abundance include (1) resource depletion; (2) the need to escape parasite or predator loads; (3) aggregation of emigrant dispersers, forming new activity areas while the natal population senesces; and (4) a combination of these factors. But whatever the reason(s), the mosaic pattern of abundance that is evident among species that are able to shift activity areas would defeat most habitat model predictions assuming static hot spots. An exception, however, would be cases of constrained aggregation, where habitat loss has left species with no options for shifting activity areas (Smallwood 2002, 2015).

PG&E's definition of Map Book Zones is flawed for the same reasons give above. CNDDB is not a scientifically credible source for determining the distributions of plant species. Also, plants are not necessarily static in location among years. In Vasco Caves Regional Preserve, for example, where cattle grazing was replaced by sheep grazing in 2005 and sheep were grazed at various levels of intensity (Smallwood et al. 2009), plants grew where we had not seem them before. These plants were present all along, however, in the seed bank of the underlying soil. With the shifts in grazing type and pressure, purple needle-grass covered slopes that used to be dominated by exotic bromes, and flowering plants we thought extirpated were found growing again.

Figure 19. *Sampling plots and relative abundance of breeding pairs of burrowing owls in the Altamont Pass Wind Resource Area in 2011 (Smallwood et al. 2013). The lowest densities are depicted as yellow and the highest densities as red. The distribution of these colors map in 2016would look almost nothing like this map.*

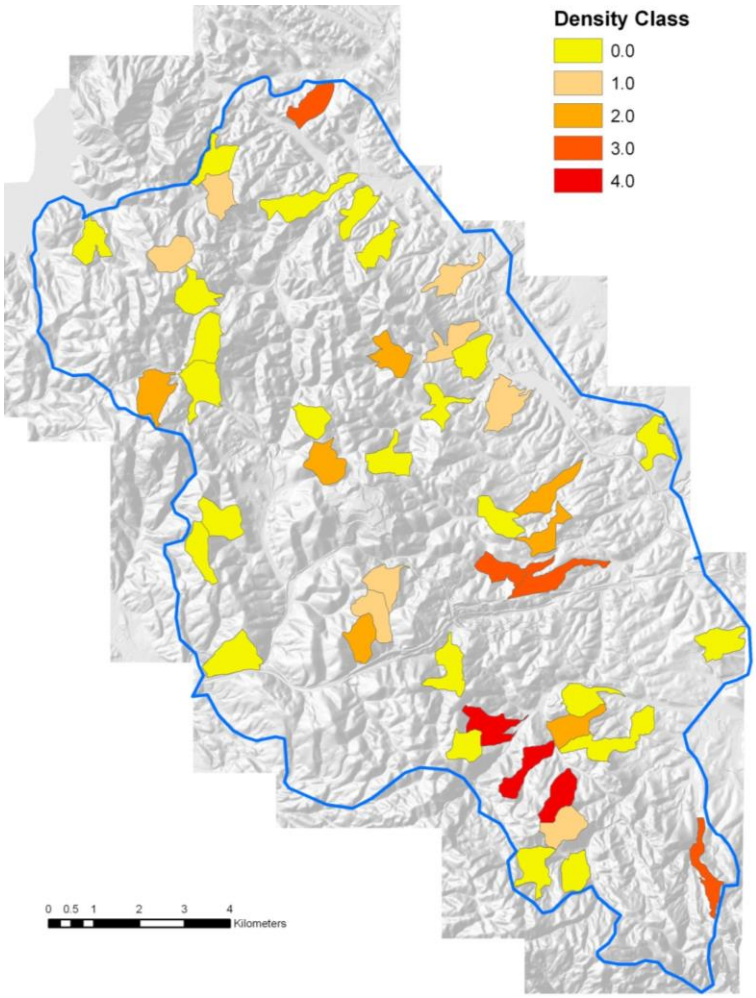
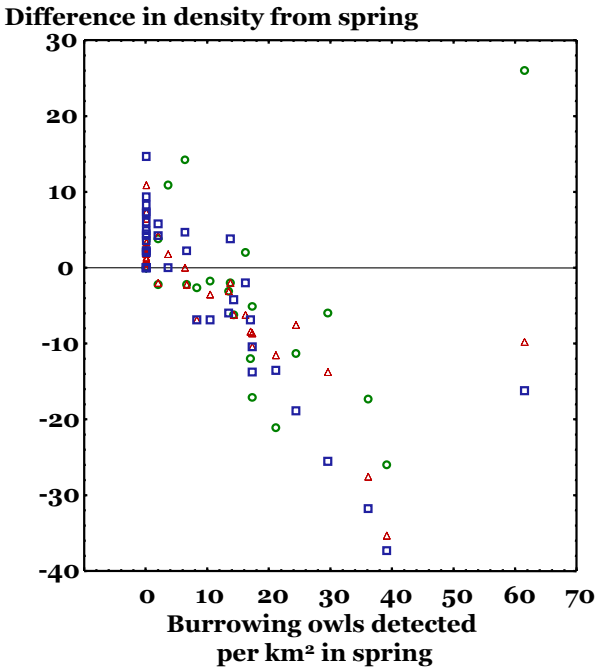


Figure 20. *Burrowing owl densities within sampling plots in the APWRA shifted between seasons as a function of density observed in spring, where green circles represent summer, red triangle represent fall, and blue squares represent winter* (Smallwood, unpublished data).



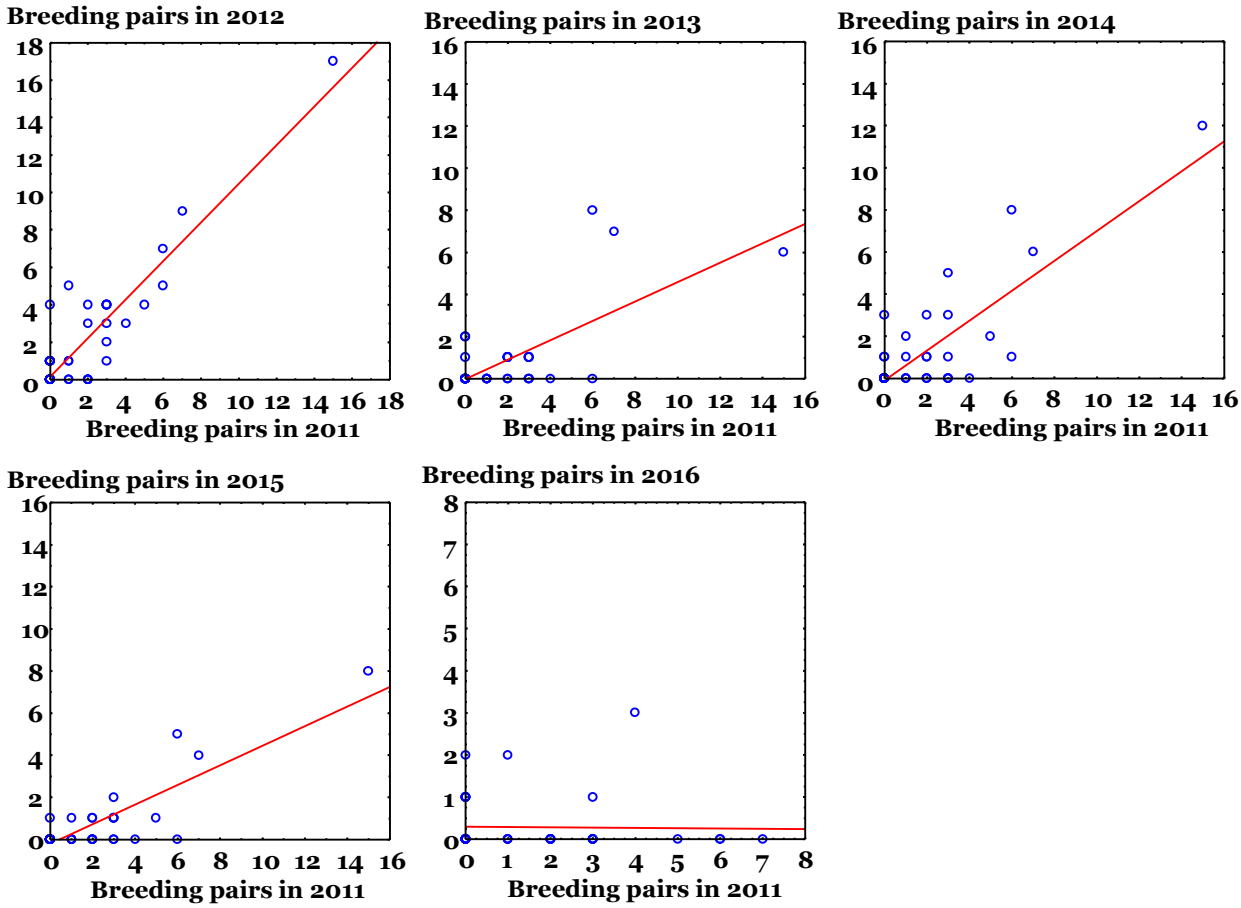


Figure 21. *Breeding pairs of burrowing owls among plots in the APWRA om 2012 through 2016 as functions of breeding pairs in 2011. Smallwood, unpublished data.*

Under 'Exceptions to the Use of Models' (page 2-12), the EA identifies areas that are not habitat or are no longer habitat. These exceptions concern me because they will be determined by PG&E, but there is no indication they will follow from the implementation of protocol detection surveys. Detection survey protocols have often been developed for special-status species for the purpose of proving absence of occurrence. These protocols are important because biologists are prone to erroneously concluding species are absent from a site. I have certainly made such mistakes many times, and I have too often seen other biologists make similar mistakes. The detection survey protocols are helpful for preventing such mistakes – from making determinations that were a little too quick. Such protocols also carry minimum qualifications of biologists making such determinations, because experience with a special-status species will almost always perform better than model predictions.

I have formulated many predictive models for occurrence likelihoods and for impact likelihoods. I have formulated indicator-level models for the special-status species hot-spots in the Yolo County HCP (Smallwood et al. 1998). I have modeled the distribution of burrowing owls on a complex landscape (Smallwood et al. 2009). I have modeled where particular bird behaviors and particular collision hazards will occur on a complex landscape (Smallwood et al. 2017). Through all of this and other modeling experience, I

have known very well that personal experience is more predictive than the models. The models are useful for testing one's notions about how the system being modeled actually works. Models are tools for improving understanding. Models should rarely if ever be used instead of protocol-level detection surveys for determining whether a species is present or absent. As an example, even though my breeding burrowing owl models performed very well by using only two or three predictor variables to explain almost all the variation in the spatial distribution of nesting owls, I would never rely on the models alone for determining whether burrowing owls are present on a site. The EA presents a false security in relying on models to assess project impacts – models the EA does not even describe.

Beginning on page 3.3-24, the EA reports impacts that are predicted from PG&E's habitat models. The impacts are presented in terms of acreages of temporary and permanent habitat lost or degraded by PG&E's operations and maintenance activities. However, as pointed out above, the reader of the EA is not informed about the nature of the habitat models other than a couple of definitions that conflict with wildlife ecology principles, the inappropriate use of CNDDB as a data source, the use of GIS, and along the way the occasional assumption for particular species impacts. For example, the EA (page 3.3-29) reports the assumption that 90% of California tiger salamanders disperse to uplands within 490 m (1,607 feet) of breeding ponds. The EA then presents estimated impacts from PG&E's habitat models based on this 490 m threshold distance. No consideration is given to the accuracy of the assumed dispersal threshold, and no uncertainty estimate is attempted. Had PG&E looked a little harder for a range of research results on the dispersal distances of California tiger salamanders they might have discovered the more recent study that found the majority of dispersing California tiger salamanders at a Contra Costa County site dispersed at least 800 m from the ponds and as far away as 2.2 km (Orloff 2011). Just one more study to review, and PG&E would have had reason to double the threshold dispersal distance in its habitat model, and thus the predicted impact would likely be much greater.

There are likely many stated assumptions like this last one for tiger salamanders that, had I more time available than a 30 day comment period for such a large document, I could have reviewed against the published literature and sometimes my own work. I was barely able to take a glance but was nevertheless quick to find a problem with the tiger salamander dispersal distance. However, there are larger problems yet, perhaps. In addition to the black box models appearing in the EA, and the inappropriate use of CNDDB input data, the output is not what is needed. Expressing the project impacts in terms of habitat acreages is merely indicator-level prediction, and informs nothing at all about electrocution mortality, collision mortality, displacement effects, barrier effects on wildlife movement, or on the numbers of individuals and larger demographic units destroyed.

What is the significance of permanently losing 39 acres of California tiger salamander habitat and 55 acres of California red-legged frog habitat? The EA offers a suggested meaning by reporting the habitat losses as tiny percentages of the available habitat (0.08% and 0.01%, respectively), but these percentages are meaningless. The available habitat was output from black box models relying inappropriately on CNDDB input

data. Even if we could trust the model predictions of available habitat, expressing the lost habitat as a percentage of available habitat loses all meaning when the available habitat is all of that occurring within a 402,440-acre planning area.

The significance of the demography at stake is lost to the ridiculous percent of habitat metric used. Not all habitat areas are equally occupied nor are they equally significant to the species. Out of 62 ponds at Military Ocean Terminal, Concord (MOTCO), all of which I would regard *a priori* as suitable California tiger salamander habitat, my standardized dip-net surveys for larvae detected California tiger salamanders in only 17 (27%) of them (Smallwood and Morrison 2006). The pond with the highest average number of larvae per sweep was 93× greater than the pond with the smallest average number of larvae per sweep other than the ponds with no larvae. Orloff (2011) found a similar pattern along a long array of pit-fall traps where she captured a wide numerical range of California tiger salamanders. Back to my 62 ponds at MOTCO, there was one pond that, if it was destroyed for some project, would result in a loss of only 1% of the cumulative pond surface area in MOTCO. Applying the PG&E modeling approach, I would conclude that the loss of this pond resulted in a loss of only 1% of the available breeding tiger salamander habitat. But because I sampled that pond and all the ponds at MOTCO, and because I was able to estimate the numbers of larvae in each pond, I know that losing that one pond would result in a loss of 31% of the tiger salamander larvae at MOTCO. A 31% impact is a lot larger than a 1% impact. Similarly, if a certain 17 of the ponds were destroyed, the PG&E approach would lead me to conclude that we lost only 9.6% of the habitat, and this would be the impact estimate. However, in reality we would have lost 100% of the larvae at MOTCO. A 100% impact would be tragic, and a whole lot larger than the 9.6% impact using the PG&E approach. Expressing impacts in terms of predicted habitat acreage or percentage loss of habitat can be highly misleading.

A more appropriate expression of impacts caused by habitat loss would be to translate the habitat areas into numbers of individuals and larger meaningful units of demography (Smallwood 2001). This approach can involve at least two methodologies. In one, actual field surveys can be used to record the locations, numbers, and demography of the species at issue. Care is needed with this approach, keeping in mind that this year's aggregations might be next year's vacant habitat due to natural causes. Given that species typically express a shifting mosaic pattern of abundance when they are able, one should not assume that vacant habitat is always vacant. In the second approach, the minimum and maximum habitat areas needed to support specific demographic units of the species (e.g., population) can be predicted from regressing numbers of animals found with increasingly larger areas searched (the approach presented in Smallwood 1999, 2001).

The Impacts Unassessed

Impacts of PG&E operations and maintenance are not just caused by habitat loss. As pointed out earlier, volant animals collide with the equipment and some animals are electrocuted on distribution poles and other electrical facilities. The EA does not appear to address these impacts. It does not even cite its own research performed on avian

collisions with transmission lines or the work of California Energy Commission grantees on electrocutions, the effectiveness of line markers, and distribution line collisions.

Bald and Golden Eagle Protection Act

Whereas the EA (Page 3.3-2) mentions the new U.S. Fish and Wildlife Service Take Rule related to bald and golden eagle fatalities caused by wind turbines, there is no mention that the sole mitigation for these takings is the retrofitting of power poles to reduce eagle electrocutions. Neither is there any mention of the U.S. Fish and Wildlife Service's prediction that soon the number of golden eagles in the USA will be reduced by 35% due to anthropogenic mortality including wind turbine collisions and distribution pole electrocutions. The U.S. Fish and Wildlife Service is looking to utilities such as PG&E to offset wind turbine impacts by retrofitting distribution poles to prevent electrocutions that otherwise would have occurred. I disagree with the new take rule and how the U.S Fish and Wildlife Service proposes to implement it (Smallwood 2016).

An example of how the Take Rule is intended to work (I suppose) can be found at the Shiloh IV wind project in the Solano Wind Resources Area. The U.S. Fish and Wildlife Service relied on utility-caused mortality data from PG&E to predict the wind turbine-caused deaths of 5 golden eagles over 5 years. To compensate for these deaths, the wind company agreed to allocate funds to pay for the retrofitting of 133 distribution poles at undisclosed locations and over an unspecified time period. Also unknown to me was whether the utility-caused mortality data were scientific data or merely outage data or incidental finds. The difference can be important because the vast majority of avian electrocutions do not result in outages, and outage data and incidental finds can introduce biases that result in the wrong types of poles being prioritized for retrofitting to prevent eagle electrocutions. This is an important point because a decade ago when I was working on electrocutions I recall that PG&E had 2.2 million poles in its service territory. With so many poles to choose from for retrofitting to APLIC standards, it is critical to choose those poles that pose the greatest risk of electrocution. Should PG&E choose the wrong poles, or even a random grab of poles, the reduction of electrocutions will be negligible.

The goal of our electrocution study from longer than a decade ago was to identify distribution poles for priority retrofit to most quickly reduce fatalities of large raptors. The report ended up being authored by BioResources Consultants because I demanded that my authorship be removed from the report. I could not accept the way the report was managed during the final month before submission, as some key findings were omitted against my will. One of the findings that was critical was that poles supporting riser elements and lightning arrestors were 16× more likely than other poles to electrocute large raptors. Adding to electrocution risk was the relative lack of other available perches in the area around the pole and corner poles and poles at the ends of taps, usually supporting irrigation pumps. In other words, we developed a model to predict electrocution hazard, and the model was highly predictive. It also performed very well in validation trials. This or a similar model should be used to prioritize pole retrofits.

POWER PURCHASE

Left unaddressed in the EA and HCP is the role of power purchase agreements on maintenance and operations of facilities and the types and magnitudes of impacts they might contribute. Does electric circuit load and intermittency affect operations and maintenance? If so, then PG&E's portfolio of energy suppliers plays a role in wildlife impacts and needs to be assessed. If the energy sources help determine the installations of new or replacement structures to upgrade facilities or to extend service to new customers, i.e., covered activities under the ITP, then the power purchase agreements have the potential to cause adverse impacts to wildlife. For example, the 2-mile circuit extensions that the HCP would allow as "minor new construction" might more often serve many small renewable energy projects with pre-permitted gen-ties. If so, then the HCP, if adopted, would facilitate industrial solar and wind projects and their associated wildlife impacts. And if more distribution poles are installed as minor new construction to service industrial solar and wind projects, then they are going to be installed with riser elements, which are 16× more likely than most poles to electrocute large raptors (see Figure 22 for example).

Figure 22. *A red-tailed hawk, having been electrocuted, lies under a distribution pole supporting riser elements, which are identifiable as cables coated in thick black insulating material and spreading to capped elements on the lower crossarm. The upper crossarm supports a switch, which also can contribution to avian electrocutions. Also, note the bare ground around the pole, which is kept bare at all times.*

I suggest that the minor new construction allowance for 2-mile circuit extensions be restricted so that it cannot be used to fast-track new energy projects. I also suggest that an EIS be prepared and that the role of power purchase agreements be discussed so that the public understands how these agreements translate into the types of equipment installed or added to existing facilities, and how these result in impacts to wildlife.

Additional Comment

There are many references listed at the end of the EA for which no citations appear in the body of text. The public ought to be enlightened about why these references are left dangling.

CUMULATIVE IMPACTS

The EA did not make a serious effort to address cumulative impacts. The HCP planning area encompasses a network of facilities stretching to all corners of 9 Counties in an ecologically sensitive portion of California. According to the EA, these facilities and their rights-of-way occupy nearly a tenth of the land area of these 9 Counties. PG&E's facilities are already causing ongoing impacts to wildlife, with more than a million bird deaths per year due to line collisions and electrocutions. Visits to facilities for inspections, patrols, outage repairs, and many other purposes also crush an unknown but undoubtedly large number of animals, including arthropods, salamanders, frogs, toads, snakes, lizards, turtles, mammals, and burrowing owls and other birds. These visits, and trenching for pipeline maintenance, already disturb nesting birds such as tricolored blackbirds, burrowing owls, golden eagles and Swainson's hawks. And these are just the ongoing impacts on PG&E's facilities. These are cumulative impacts that need to be addressed.

Other cumulative impacts that ought to be assessed include urban sprawl, the proliferation of distribution warehouses, the proposed Delta Tunnels, ongoing wildlife mortality on roadways in the 9 Counties, and the use of rodenticides by the region's ranchers, among many other impacts. The reason there are 69 special-status species of terrestrial vertebrates in these 9 Counties is cumulative impacts. An EIS is needed to appropriately assess these impacts.

MITIGATION

The EA lists avoidance and minimization measures and best management practices. If I had longer than a mere 30 day comment period on the EA, I would address these measures. The comment period was not long enough. Instead, I will comment on mitigation measures that I believe would be most effective and which are missing from the EA.

Research and Monitoring

There has been almost no scientific monitoring of electrocution fatalities of birds on distribution poles, and almost no scientific monitoring of collisions with distribution

lines in California. There's been one monitoring effort of collision fatalities with transmission lines at Mare Island (no citation of this study appears in the EA), and there was a study I designed and conducted in the Central Valley, but otherwise there's nothing known about the collision impacts of distribution lines or transmission lines owned by PG&E. A decade ago I recall PG&E biologists insisting that all avian electrocutions are known because each electrocution will cause an outage that gets investigated by a lineman, who buries the bird on site. But most electrocutions do not cause outages, as my crew discovered during our surveys and as I am often reminded by rehabilitation facilities sending me reports of wildlife injured on distribution poles. Just the other day I received two more email reports of great-horned owl electrocution injuries in the Bay Area. Most electrocution victims are never found or documented, so the ongoing impacts must be much greater than widely believed.

Scientific monitoring is needed to estimate impacts caused by vehicle traffic associated with PG&E facilities, by line collisions, by electrocutions, and by trenching to access gas pipelines. This monitoring is needed to estimate levels of incidental take so that compensatory mitigation can be formulated. I suggest that a healthy portion of that mitigation should fund research on retrofitting poles to make them safer to birds. It should fund research on line markers and line marker effectiveness. It should fund research that would inform the future siting of gas lines, transmission lines and distribution lines to minimize impacts.

The current state of knowledge on electrocutions and line collisions is grossly inadequate. In my opinion, anecdotes, speculation, and simple deductive logic rule on decisions over which poles to retrofit and which lines to mark and how to mark them. For example, a common notion is that poles with transformer pots electrocute disproportionately more birds than poles with other types of equipment. However, through research we found that poles with transformer pots electrocuted fewer birds on average unless the pole also supported lightning arrestors. Because poles often support multiple pieces of equipment, confounding among factors clouds perceptions about why some poles are more lethal to birds than others. Deductive logic seems to rule on which perch guards to use and whether they are effective, but there are many problems with the use of perch guards that also need to be examined through research. For example, perch guard installations can often force birds determined to perch on the pole into positions that are actually closer to phased elements and therefore more dangerous (Figure 23). Research is needed on which circumstances perch guards effectively reduce electrocutions, and how perch guards should be deployed.

Research is need on line markers. The majority of dangerous spans of distribution and transmission lines remain unmarked. Last year I witnessed a duck collide with unmarked distribution lines, resulting in a dead duck. The unwitnessed toll of line collisions is estimated in the hundreds of thousands within the HCP planning area alone. Lines that sag across ravines are nearly invisible when viewed with terrain backdrops (common in ravines), so these lines need to be marked. One such set of distribution lines killed a golden eagle in 2011, and still unmarked it has continued to kill birds, which I document nearly every time I visit that span. Which line markers are effective? I advised on a study of line markers that reduced collision fatalities during the

study (Yee 2007), but when I visited the lines a few years later only one of hundreds of installed markers remained functional; the rest had tangled or dropped from their mounts (Figure 24).

Research on the effectiveness of pole retrofits and line markers should be experimental in nature. It is important to control the variation in environmental and structural variables to the degrees possible, and that is best accomplished through sound experimental design. The principles of experimental design and analysis for use with impact-reduction mitigation strategies are summarized in Sinclair and DeGeorge (2016).

Research is also needed on siting of future facilities. By monitoring impacts on existing facilities, much can be learned about landscape settings that influence electrocution and collision fatalities, as well as automobile traffic fatalities. Just as I was able to develop map-based models to micro-site new wind turbines to minimize collision impacts to golden eagle, red-tailed hawk, American kestrel and burrowing owl (Smallwood et al. 2017), map-based models of electrocution risk and line collision risk can be developed to macro- and micro-site new facilities. The same can be done for traffic impacts. Compensatory mitigation should be directed toward these research endeavors which will do far more good for wildlife than the collection of best management practices listed in the EA.

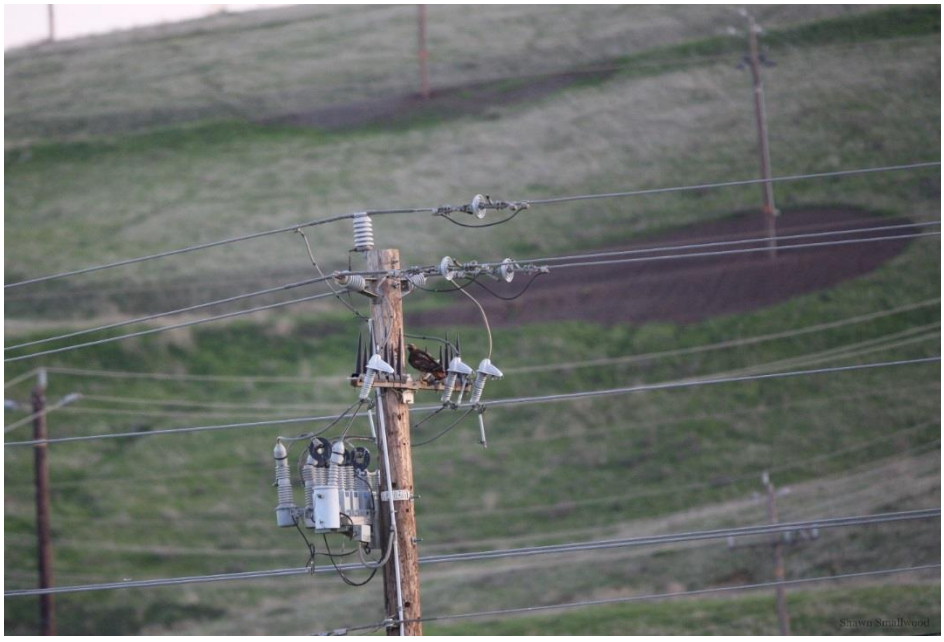


Figure 23. *Perch guards force a determined red-tailed to perch closer to lightning arrestors on a pole that also supports capacitor banks and pots. Fortunately, the dangerous equipment on this pole has been insulated and capped. Photo by Shawn Smallwood.*

Figure 24A. *Line marker deployed in experimental design to test whether line collisions could be reduced for sandhill crane and other birds (Yee 2007). Photo by Shawn Smallwood.*

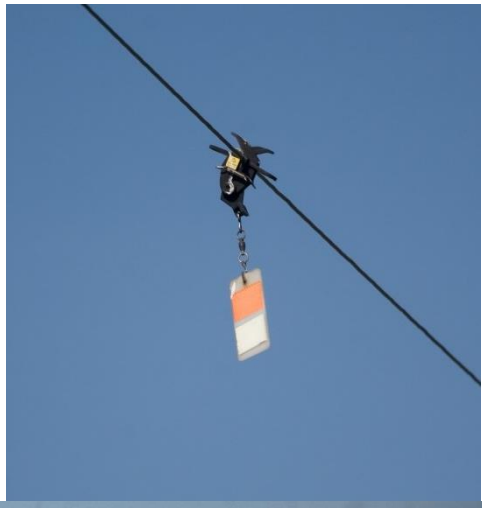


Figure 24B. *Several years after deployment the line markers used to experimentally test whether line collisions could be reduced for sandhill crane and other birds (Yee 2007) were broken, twisted and missing due to exposure to sun, rain and wind. Durability is an issue. Photo by Shawn Smallwood.*

Donations to Wildlife Rehabilitation Facilities

Despite efforts to minimize and reduce the impacts of PG&E's facilities on wildlife, impacts will continue at various levels. Birds and other wildlife will continue to be injured by electrocution and line collisions, and many of them will be discovered by biologists and concerned citizens. These injured animals are often taken to wildlife rehabilitation facilities (Figure 25), where most are euthanized either because the injuries are too great for any hope of releasing the animal back to the wild or because operating budgets are too low to afford the level of care needed for rehabilitation and

release. The truth is that the non-profit organizations serving to rehabilitate wildlife are almost always operating on shoestring budgets. Many more injured wildlife can be rehabilitated and released by increasing the operating budgets of wildlife rehabbers.

Figure 25. *Short-eared owl injured by distribution line collision. It was later euthanized at the UC Davis Wildlife Hospital. I have many records of wildlife injured on distribution poles and lines. Photo by Brian Karas.*

I recommend that compensatory mitigation for ongoing and future impacts caused by PG&E operations and maintenance be provided in the form of donations to wildlife rehabilitation facilities. I recommend that the fund be apportioned to all of the available rehabilitation facilities within the 9 Counties composing the HCP planning area. If not to all of them, then I would recommend funding being directed to Native Songbird Care in Sebastopol and Lindsay Wildlife Hospital in Walnut Creek.

The amount of the fund could be assessed by estimating the numbers of injured animals found and delivered to rehabilitation facilities and by interviewing rehabilitation facilities for their costs. Little has been done in support of such an assessment, but Leyvas and Smallwood (2015) initiated a small effort on the cost side of the problem. We surveyed 38 rehabilitation facilities to assess the cost of rehabilitating raptors injured by wind turbines, and we ended up recommending $3,230/injured raptor would serve as a reasonable interim mitigation cost. However, many animals injured or killed by PG&E facilities will represent birds other than raptors, as well as mammals, reptiles and amphibians. Most of these non-raptor animals likely cost less to rehabilitate. In the

absence of any additional cost summaries from rehabilitation facilities, I hazard to guess that $500 per injured animal would be reasonable. These costs would need to be multiplied by the number of injured animals ending up in rehabilitation facilities, and these numbers could be obtained by interviewing the rehabbers. I have received many injury reports from one facility, but I know that I have not received a comprehensive accounting of the injured animals they treat.

SUMMARY COMMENTS

The impacts of PG&E's operations and maintenance in the HCP planning area warrant a much more comprehensive assessment than typically provided in an EA, and certainly more than provided in this EA. An EIS should be prepared. And it should be prepared for a much longer list of candidate species to be covered by the ITP. It should be prepared to address all of the impacts of operations and maintenance, including the very large numbers of birds killed by electrocution and collision with PG&E's facilities. The habitat metric needs to be replaced by a scientifically defensible numerical metric. After all, ITPs are supposed to cover individual animals and not acres of habitat. The EIS should address power purchase agreements, because they play significant roles in load management and the equipment deployed, and the equipment used bears on wildlife impacts. The EIS should also address the use of herbicides, rodenticides and insecticides, because these uses can also cause injury and death to special-status species.

Mitigation should include scientific monitoring of PG&E's impacts. It should also include compensatory mitigation to offset those impacts that cannot be reduced through other measures. This compensatory mitigation should include funding of primary scientific research for the purpose of finding solutions to ongoing impacts and for macro- and micro-siting solutions to minimize impacts of future projects. Funding should also be provided to wildlife rehabilitation facilities who care for many of the animals injured by PG&E's facilities.

Thank you for your consideration,

Shawn Smallwood, Ph.D.

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Appendix 1. *Electrocution and line collision fatalities found during 5 searches at 6,375 distribution poles and intervening spans over the course of one year in the Central Valley, California. Bold font denotes special-status species.*

Species	**Found carcasses**
American white pelican	15
White-faced ibis	1
Great blue heron	76
Green heron	2
Black-crowned night heron	20
Great egret	24
Snowy egret	7
Cattle egret	1
Heron	1
Egret	4
American bittern	4
Least bittern	1
Sora	2
Virginia rail	1
Sandhill crane	4
American avocet	1
Black-necked stilt	1
Greater yellowlegs	1
Killdeer	4
American coot	66
Common moorhen	26
Tundra swan	2
Greater white-fronted goose	1
Snow goose	4
Mallard	15
Northern shoveler	4
American wigeon	1
Cinnamon teal	1
Duck	38
California gull	1
Gull	1
Turkey vulture	18
Golden eagle	2
Cooper's hawk	5
Prairie falcon	1
American kestrel	10
Ferruginous hawk	1
Red-tailed hawk	97
Swainson's hawk	19
Red-tailed hawk or Swainson's hawk	2
Red-shouldered hawk	2

Species	**Found carcasses**
Large raptor	1
Wild turkey	1
Ring-necked pheasant	45
Common peafowl	3
Barn owl	83
Great horned owl	18
Short-eared owl	3
Burrowing owl	4
Mourning dove	3
Rock pigeon	6
Northern flicker	2
Acorn woodpecker	1
Yellow-billed magpie	6
Common raven	11
American crow	28
European starling	3
Western bluebird	1
Northern mockingbird	1
Black-throated gray warbler	1
Orange-crowned warbler	1
Small bird (songbird)	18
Western meadowlark	9
Brewer's blackbird	4
Red-winged blackbird	4
Tricolored blackbird	1
Blackbird	2
Budgerigar	1
Large wading bird	1
large nonraptor	2
Medium nonraptor	9
Medium bird	29
Large bird	13
Small nonraptor	2
Unknown	12
Total	816

Appendix 2. *Electrocution and line collision fatalities found during scientific monitoring of wind turbine-caused fatalities in the Altamont Pass Wind Resource Area, 1998-2015. Bold font denotes special-status species.*

	Found carcasses	
Species	**Electrocutions**	**Line collisions**
Great blue heron	1	5
Snowy egret		1
Heron		1
Wader		1
Long-billed curlew		1
Mallard	1	4
California gull		23
Herring gull		1
Gull	1	34
Turkey vulture	1	
Golden eagle	11	7
Red-tailed hawk	94	11
Ferruginous hawk	2	
American kestrel	1	1
Great-horned owl	2	
Barn owl	2	9
Burrowing owl		2
Raptor	2	
Rock pigeon	2	16
European starling	18	3
Horned lark		1
Loggerhead shrike	1	1
Northern shrike		1
Mountain bluebird	1	
Bluebird		1
American crow	4	
Common raven	28	6
Corvid	1	
Townsend's warbler	1	
Black-throated gray warbler	1	
White-crowned sparrow		1
Western meadowlark		1
Brewer's blackbird		3
Blackbird	1	
Small bird	3	2
Medium bird	1	
Large bird		1
Bird	2	
Total	182	138

Kenneth Shawn Smallwood
Curriculum Vitae

3108 Finch Street
Davis, CA 95616
Phone (530) 756-4598
Cell (530) 601-6857
puma@dcn.org

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

Ecologist

Expertise

- Finding solutions to controversial problems related to wildlife interactions with human industry, infrastructure, and activities;
- Wildlife monitoring and field study using GPS, thermal imaging, behavior surveys;
- Using systems analysis and experimental design principles to identify meaningful ecological patterns that inform management decisions.

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

- 476 professional publications, including:
- 81 peer reviewed publications
- 24 in non-reviewed proceedings
- 369 reports, declarations, posters and book reviews
- 8 in mass media outlets
- 87 public presentations of research results at meetings
- Reviewed many professional papers and reports
- Testified in 4 court cases.

Editing for scientific journals: Guest Editor, *Wildlife Society Bulletin*, 2012-2013, of invited papers representing international views on the impacts of wind energy on wildlife and how to mitigate the impacts. Associate Editor, *Journal of Wildlife Management*, March 2004 to 30 June 2007. Editorial Board Member, *Environmental Management*, 10/1999 to 8/2004. Associate Editor, *Biological Conservation*, 9/1994 to 9/1995.

Member, Alameda County Scientific Review Committee (SRC), August 2006 to April 2011. The

five-member committee investigated causes of bird and bat collisions in the Altamont Pass Wind Resource Area, and recommended mitigation and monitoring measures. The SRC reviewed the science underlying the Alameda County Avian Protection Program, and advised the County on how to reduce wildlife fatalities.

Consulting Ecologist, 2004-2007, California Energy Commission (CEC). Provided consulting services as needed to the CEC on renewable energy impacts, monitoring and research, and produced several reports. Also collaborated with Lawrence-Livermore National Lab on research to understand and reduce wind turbine impacts on wildlife.

Consulting Ecologist, 1999-2013, U.S. Navy. Performed endangered species surveys, hazardous waste site monitoring, and habitat restoration for the endangered San Joaquin kangaroo rat, California tiger salamander, California red-legged frog, California clapper rail, western burrowing owl, salt marsh harvest mouse, and other species at Naval Air Station Lemoore; Naval Weapons Station, Seal Beach, Detachment Concord; Naval Security Group Activity, Skaggs Island; National Radio Transmitter Facility, Dixon; and, Naval Outlying Landing Field Imperial Beach.

Part-time Lecturer, 1998-2005, California State University, Sacramento. Instructed Mammalogy, Behavioral Ecology, and Ornithology Lab, Contemporary Environmental Issues, Natural Resources Conservation.

Senior Ecologist, 1999-2005, BioResource Consultants. Designed and implemented research and monitoring studies related to avian fatalities at wind turbines, avian electrocutions on electric distribution poles across California, and avian fatalities at transmission lines.

Chairman, Conservation Affairs Committee, The Wildlife Society--Western Section, 1999-2001. Prepared position statements and led efforts directed toward conservation issues, including travel to Washington, D.C. to lobby Congress for more wildlife conservation funding.

Systems Ecologist, 1995-2000, Institute for Sustainable Development. Headed ISD's program on integrated resources management. Developed indicators of ecological integrity for large areas, using remotely sensed data, local community involvement and GIS.

Associate, 1997-1998, Department of Agronomy and Range Science, University of California, Davis. Worked with Shu Geng and Mingua Zhang on several studies related to wildlife interactions with agriculture and patterns of fertilizer and pesticide residues in groundwater across a large landscape.

Lead Scientist, 1996-1999, National Endangered Species Network. Informed academic scientists and environmental activists about emerging issues regarding the Endangered Species Act and other environmental laws. Testified at public hearings on endangered species issues.

Ecologist, 1997-1998, Western Foundation of Vertebrate Zoology. Conducted field research to determine the impact of past mercury mining on the status of California red-legged frogs in Santa Clara County, California.

Senior Systems Ecologist, 1994-1995, EIP Associates, Sacramento, California. Provided consulting services in environmental planning, and quantitative assessment of land units for their conservation and restoration opportunities basedon ecological resource requirements of 29 special-status species. Developed ecological indicators for prioritizing areas within Yolo County to receive mitigation funds for habitat easements and restoration.

Post-Graduate Researcher, 1990-1994, Department of Agronomy and Range Science, *U.C. Davis*. Under Dr. Shu Geng's mentorship, 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. Managed and analyzed a data base of energy use in California agriculture. Assisted with landscape (GIS) study of groundwater contamination across Tulare County, California.

Work experience in graduate school: Co-taught Conservation Biology with Dr. Christine Schonewald, 1991 & 1993, UC Davis Graduate Group in Ecology; Reader for Dr. Richard Coss's course on Psychobiology in 1990, UC Davis Department of Psychology; Research Assistant to Dr. Walter E. Howard, 1988-1990, UC Davis Department of Wildlife and Fisheries Biology, testing durable baits for pocket gopher management in forest clearcuts; Research Assistant to Dr. Terrell P. Salmon, 1987-1988, UC Wildlife Extension, Department of Wildlife and Fisheries Biology, developing 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 to Dr. E. Lee Fitzhugh, 1985-1987, UC Cooperative Extension, Department of Wildlife and Fisheries Biology, developing and implementing statewide mountain lion track count for long-term monitoring.

Fulbright Research Fellow, Indonesia, 1988. Tested use of new sampling methods for numerical monitoring of Sumatran tiger and six other species of endemic felids, and evaluated methods used by other researchers.

Projects

Repowering wind energy projects through careful siting of new wind turbines using map-based collision hazard models to minimize impacts to volant wildlife. Funded by wind companies (principally NextEra Renewable Energy, Inc.), California Energy Commission and East Bay Regional Park District, I have collaborated with a GIS analyst and managed a crew of five field biologists performing golden eagle behavior surveys and nocturnal surveys on bats and owls. The goal is to quantify flight patterns for development of predictive models to more carefully site new wind turbines in repowering projects. Focused behavior surveys began May 2012 and continue. Collision hazard models have been prepared for seven wind projects, three of which were built. Planning for additional repowering projects is underway.

Test avian safety of new mixer-ejector wind turbine (MEWT). Designed and implemented a before-after, control-impact experimental design to test the avian safety of a new, shrouded wind turbine developed by Ogin Inc. (formerly known as FloDesign Wind Turbine Corporation). Supported by a $718,000 grant from the California Energy Commission's Public Interest Energy Research program and a 20% match share contribution from Ogin, I managed a crew of seven field biologists who

performed periodic fatality searches and behavior surveys, carcass detection trials, nocturnal behavior surveys using a thermal camera, and spatial analyses with the collaboration of a GIS analyst. Field work began 1 April 2012 and ended 30 March 2015 without Ogin installing its MEWTs, but we still achieved multiple important scientific advances.

Reduce avian mortality due to wind turbines at Altamont Pass. Studied wildlife impacts caused by 5,400 wind turbines at the world's most notorious wind resource area. Studied how impacts are perceived by monitoring and how they are affected by terrain, wind patterns, food resources, range management practices, wind turbine operations, seasonal patterns, population cycles, infrastructure management such as electric distribution, animal behavior and social interactions.

Reduce avian mortality on electric distribution poles. Directed research toward reducing bird electrocutions on electric distribution poles, 2000-2007. Oversaw 5 founds of fatality searches at 10,000 poles from Orange County to Glenn County, California, and produced two large reports.

Cook *et al*. v. Rockwell International *et al*., No. 90-K-181 (D. Colorado). Provided 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 reports based on four site visits and an extensive document review of burrowing animals. 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. I testified in federal court in November 2005, and my clients were subsequently awarded a $553,000,000 judgment by a jury. After appeals the award was increased to two billion dollars.

Hanford Nuclear Reservation Litigation. Provided 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 a certain 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.

Expert testimony and declarations on proposed residential and commercial developments, gas-fired power plants, wind, solar and geothermal projects, water transfers and water transfer delivery systems, endangered species recovery plans, Habitat Conservation Plans and Natural Communities Conservation Programs. Testified before multiple government agencies, Tribunals, Boards of Supervisors and City Councils, and participated with press conferences and depositions. Prepared expert witness reports and court declarations, which are summarized under Reports (below).

Protocol-level surveys for special-status species. Used California Department of Fish and Wildlife and US Fish and Wildlife Service protocols to search for California red-legged frog, California tiger salamander, arroyo southwestern toad, blunt-nosed leopard lizard, western pond turtle, giant kangaroo rat, San Joaquin kangaroo rat, San Joaquin kit fox, western burrowing owl, Swainson's hawk, Valley elderberry longhorn beetle and other special-status species.

Conservation of San Joaquin kangaroo rat. Performed research to identify factors responsible for the decline of this endangered species at Lemoore Naval Air Station, 2000-2013, and implemented

habitat enhancements designed to reverse the trend and expand the population.

Impact of West Nile Virus on yellow-billed magpies. Funded by Sacramento-Yolo Mosquito and Vector Control District, 2005-2008, compared survey results pre- and post-West Nile Virus epidemic for multiple bird species in the Sacramento Valley, particularly on yellow-billed magpie and American crow due to susceptibility to WNV.

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

Mapping of biological resources along Highways 101, 46 and 41. Used GPS and GIS to delineate vegetation complexes and locations of special-status species along 26 miles of highway in San Luis Obispo County, 14 miles of highway and roadway in Monterey County, and in a large area north of Fresno, including within reclaimed gravel mining pits.

GPS mapping and monitoring at restoration sites and at Caltrans mitigation sites. Monitored the success of elderberry shrubs at one location, the success of willows at another location, and the response of wildlife to the succession of vegetation at both sites. Also used GPS to monitor the response of fossorial animals to yellow star-thistle eradication and natural grassland restoration efforts at Bear Valley in Colusa County and at the decommissioned Mather Air Force Base in Sacramento County.

Mercury effects on Red-legged Frog. Assisted Dr. Michael Morrison and US Fish and Wildlife Service in assessing the possible impacts of historical mercury mining on the federally listed California red-legged frog in Santa Clara County. Also measured habitat variables in 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." Submitted 188 signatures of scientists and environmental professionals concerned about No Surprises rule US Fish and Wildlife Service, National Marine Fisheries Service, all US Senators.

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

Assessments of agricultural production system and environmental technology transfer to China. Twice visited 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.

Yolo County Habitat Conservation Plan. Conducted landscape ecology study of Yolo County to spatially prioritize allocation of mitigation efforts to improve ecosystem functionality within the County from the perspective of 29 special-status species of wildlife and plants. 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 developed implementation strategies.

Mountain lion track count. Developed and conducted a 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. Track survey transect was established on dusty, dirt roads within randomly selected quadrats.

Sumatran tiger and other felids. Upon award of Fulbright Research Fellowship, I designed and initiated track counts for seven species of wild cats in Sumatra, including Sumatran tiger, fishing cat, and golden cat. Spent four months on Sumatra and Java in 1988, and learned Bahasa Indonesia, the official Indonesian language.

Wildlife in agriculture. Beginning as post-graduate research, I 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 since 1989 with a hiatus of 1996-2004. The data are analyzed using GIS and methods from landscape ecology, and the results 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.

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 clear-cuts. Developed gopher sampling methods and tested various poison baits and baiting regimes in the largest-ever field study of pocket gopher management in forest plantations, involving 68 research plots in 55 clear-cuts 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, as well as a rating system for assigning priority research and control to exotic species in California, based on economic, environmental, and human health hazards.

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Comments on Environmental Documents

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- The Villages of Lakeview EIR (2017; 28 pp);
- Notes on Proposed Study Options for Trail Impacts on Northern Spotted Owl (2017; 4 pp);
- San Gorgonio Crossings EIR (2017; 22 pp);
- Replies to responses on Jupiter Project IS and MND (2017; 12 pp);
- MacArthur Transit Village Project Modified 2016 CEQA Analysis (2017; 12 pp);
- Central SoMa Plan DEIR (2017; 14 pp);
- Colony Commerce Center Specific Plan DEIR (2016; 16 pp);
- Fairway Trails Improvements MND (2016; 13 pp);
- Review of Avian-Solar Science Plan (2016; 28 pp);
- Replies to responses on Initial Study for Pyramid Asphalt (2016; 5 pp);
- Initial Study for Pyramid Asphalt (2016; 4 pp);
- Agua Mansa Distribution Warehouse Project Initial Study (2016; 14 pp);
- Santa Anita Warehouse IS and MND (2016; 12 pp);
- CapRock Distribution Center III DEIR (2016: 12 pp);
- Orange Show Logistics Center Initial Study and MND (2016; 9 pp);
- City of Palmdale Oasis Medical Village Project IS and MND (2016; 7 pp);
- Comments on proposed rule for incidental eagle take (2016, 49 pp);
- Grapevine Specific and Community Plan FEIR (2016; 25 pp);
- Grapevine Specific and Community Plan DEIR (2016; 15 pp);
- Clinton County Zoning Ordinance for Wind Turbine siting (2016);
- Hallmark at Shenandoah Warehouse Project Initial Study (2016; 6 pp);
- Tri-City Industrial Complex Initial Study (2016; 5 pp);
- Hidden Canyon Industrial Park Plot Plan 16-PP-02 (2016; 12 pp);
- Kimball Business Park DEIR (2016; 10 pp);
- Jupiter Project IS and MND (2016; 9 pp);
- Revised Draft Giant Garter Snake Recovery Plan of 2015 (2016, 18 pp);
- Palo Verde Mesa Solar Project Draft Environmental Impact Report (2016; 27 pp);
- Reply Witness Statement on Fairview Wind Project, Ontario, Canada (2016; 14 pp);
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- Supplementary Reply Witness Statement Amherst Island Wind Farm, Ontario (2015, 38 pp);
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- Proposed Section 24 Specific Plan Agua Caliente Band of Cahuilla Indians DEIS (2015, 9 pp);
- Replies to comments 24 Specific Plan Agua Caliente Band of Cahuilla Indians FEIS (2015, 6 pp);
- Willow Springs Solar Photovoltaic Project DEIR (2015; 28 pp);
- Sierra Lakes Commerce Center Project DEIR (2015, 9 pp);
- Columbia Business Center MND (2015; 8 pp);
- West Valley Logistics Center Specific Plan DEIR (2015, 10 pp);
- World Logistic Center Specific Plan FEIR (2015, 12 pp);
- Bay Delta Conservation Plan EIR/EIS (2014, 21 pp);
- Addison Wind Energy Project DEIR (2014, 32 pp);
- Response to Comments on the Addison Wind Energy Project DEIR (2014, 15 pp);
- Addison and Rising Tree Wind Energy Project FEIR (2014, 12 pp);
- Alta East Wind Energy Project FEIS (2013, 23 pp);
- Blythe Solar Power Project Staff Assessment, California Energy Commission (2013, 16 pp);
- Clearwater and Yakima Solar Projects DEIR (2013, 9 pp);
- Cuyama Solar Project DEIR (2014, 19 pp);
- Draft Desert Renewable Energy Conservation Plan (DRECP) EIR/EIS (2015, 49 pp);
- Kingbird Solar Photovoltaic Project EIR (2013, 19 pp);
- Lucerne Valley Solar Project Initial Study & Mitigated Negative Declaration (2013, 12 pp);
- Palen Solar Electric Generating System Final Staff Assessment of California Energy Commission, (2014, 20 pp);
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- Rising Tree Wind Energy Project DEIR (2014, 32 pp);
- Response to Comments on the Rising Tree Wind Energy Project DEIR (2014, 15 pp);
- Soitec Solar Development Project Draft PEIR (2014, 18 pp);
- Comment on the Biological Opinion (08ESMF-00-2012-F-0387) of Oakland Zoo expansion on Alameda whipsnake and California red-legged frog (2014; 3 pp);
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- Declaration in opposition to BLM fracking (2013; 5 pp);
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- Reply to Staff Responses to Comments on Soccer Center Solar Project Mitigated Negative Declaration (2013; 6 pp);
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- Declaration on Campo Verde Solar project FEIR (2013; 11pp);
- Neg Dec comments on Davis Sewer Trunk Rehabilitation (2013; 8 pp);
- Declaration on North Steens Transmission Line FEIS (2012; 62 pp);
- City of Lancaster Revised Initial Study for Conditional Use Permits 12-08 and 12-09, Summer Solar and Springtime Solar Projects (2012; 8 pp);
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- Solar Gen 2 Array Project DEIR (2012; 16 pp);
- Ocotillo Sol Project EIS (2012; 4 pp);
- Beacon Photovoltaic Project DEIR (2012; 5 pp);
- Declaration on Initial Study and Proposed Negative Declaration for the Butte Water District 2012 Water Transfer Program (2012; 11 pp);
- Mount Signal and Calexico Solar Farm Projects DEIR (2011; 16 pp);
- City of Elk Grove Sphere of Influence EIR (2011; 28 pp);
- Comment on Sutter Landing Park Solar Photovoltaic Project MND (2011; 9 pp);
- Statement of Shawn Smallwood, Ph.D. Regarding Proposed Rabik/Gudath Project, 22611 Coleman Valley Road, Bodega Bay (CPN 10-0002) (2011; 4 pp);
- Declaration of K. Shawn Smallwood on Biological Impacts of the Ivanpah Solar Electric Generating System (ISEGS) (2011; 9 pp);
- Comments on Draft Eagle Conservation Plan Guidance (2011; 13 pp);
- Comments on Draft EIR/EA for Niles Canyon Safety Improvement Project (2011; 16 pp);
- Declaration of K. Shawn Smallwood, Ph.D., on Biological Impacts of the Route 84 Safety Improvement Project (2011; 7 pp);
- Rebuttal Testimony of Witness #22, K. Shawn Smallwood, Ph.D, on Behalf of Intervenors Friends of The Columbia Gorge & Save Our Scenic Area (2010; 6 pp);
- Prefiled Direct Testimony of Witness #22, K. Shawn Smallwood, Ph.D, on Behalf of Intervenors Friends of the Columbia Gorge & Save Our Scenic Area. Comments on Whistling Ridge Wind Energy Power Project DEIS, Skamania County, Washington (2010; 41 pp);
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- Replies to responses to comments on Mitigated Negative Declaration of the proposed Mining Permit (MIN 04-01) and Modification of Use Permit 96-02 at North Table Mountain (2006; 5 pp);
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- Windy Point Wind Farm Environmental Review and EIS (2006; 14 pp and 36 Powerpoint slides in reply to responses to comments);
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- Conditional Use Permit renewals from Alameda County for wind turbine operations in the Altamont Pass Wind Resource Area (2003; 41 pp);
- UC Davis Long Range Development Plan of 2003, particularly with regard to the Neighborhood Master Plan (2003; 23 pp);
- Anderson Marketplace Draft Environmental Impact Report (2003: 18 pp + 3 plates of photos);
- Negative Declaration of the proposed expansion of Temple B'nai Tikyah (2003: 6 pp);
- Antonio Mountain Ranch Specific Plan Public Draft EIR (2002: 23 pp);
- Response to testimony of experts at the East Altamont Energy Center evidentiary hearing on biological resources (2002: 9 pp);
- Revised Draft Environmental Impact Report, The Promenade (2002: 7 pp);
- Recirculated Initial Study for Calpine's proposed Pajaro Valley Energy Center (2002: 3 pp);
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- Replies to response to comments in Final Environmental Impact Report, Atwood Ranch Unit III Subdivision (2003: 22 pp);
- Draft Environmental Impact Report, Atwood Ranch Unit III Subdivision (2002: 19 pp + 8 photos on 4 plates);
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- Initial Study and Negative Declaration, Silver Bend Apartments, Placer County (2002: 13 pp);
- UC Merced Long-range Development Plan DEIR and UC Merced Community Plan DEIR (2001: 26 pp);
- Initial Study, Colusa County Power Plant (2001: 6 pp);
- Comments on Proposed Dog Park at Catlin Park, Folsom, California (2001: 5 pp + 4 photos);
- Pacific Lumber Co. (Headwaters) Habitat Conservation Plan and Environmental Impact Report (1998: 28 pp);
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- Permit (PRT-823773) Amendment for the Natomas Basin Habitat Conservation Plan, Sacramento, CA (Fed. Reg. 63 (101): 29020-29021) (1998);
- Draft Recovery Plan for the Giant Garter Snake (*Thamnophis gigas*). (Fed. Reg. 64(176): 49497-49498) (1999: 8 pp);
- Review of the Draft Recovery Plan for the Arroyo Southwestern Toad (*Bufo microscaphus*

californicus) (1998);
- Ballona West Bluffs Project Environmental Impact Report (1999: oral presentation);
- California Board of Forestry's proposed amended Forest Practices Rules (1999);
- Negative Declaration for the Sunset Skyranch Airport Use Permit (1999);
- Calpine and Bechtel Corporations' Biological Resources Implementation and Monitoring Program (BRMIMP) for the Metcalf Energy Center (2000: 10 pp);
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- US Fish and Wildlife Service Section 7 consultation with the California Energy Commission regarding Calpine and Bechtel Corporations' Metcalf Energy Center (2000: 4 pp);
- California Energy Commission's Preliminary Staff Assessment of the proposed Metcalf Energy Center (2000: 11 pp);
- Site-specific management plans for the Natomas Basin Conservancy's mitigation lands, prepared by Wildlands, Inc. (2000: 7 pp);
- Affidavit of K. Shawn Smallwood in Spirit of the Sage Council, et al. (Plaintiffs) vs. Bruce Babbitt, Secretary, U.S. Department of the Interior, et al. (Defendants), Injuries caused by the No Surprises policy and final rule which codifies that policy (1999: 9 pp).

Comments on other Environmental Review Documents:

- Proposed Regulation for California Fish and Game Code Section 3503.5 (2015: 12 pp);
- Statement of Overriding Considerations related to extending Altamont Winds, Inc.'s Conditional Use Permit PLN2014-00028 (2015; 8 pp);
- Draft Program Level EIR for Covell Village (2005; 19 pp);
- Bureau of Land Management Wind Energy Programmatic EIS Scoping document (2003: 7 pp.);
- NEPA Environmental Analysis for Biosafety Level 4 National Biocontainment Laboratory (NBL) at UC Davis (2003: 7 pp);
- Notice of Preparation of UC Merced Community and Area Plan EIR, on behalf of The Wildlife Society—Western Section (2001: 8 pp.);
- Preliminary Draft Yolo County Habitat Conservation Plan (2001; 2 letters totaling 35 pp.);
- Merced County General Plan Revision, notice of Negative Declaration (2001: 2 pp.);
- Notice of Preparation of Campus Parkway EIR/EIS (2001: 7 pp.);
- Draft Recovery Plan for the bighorn sheep in the Peninsular Range (*Ovis candensis*) (2000);
- Draft Recovery Plan for the California Red-legged Frog (*Rana aurora draytonii*), on behalf of The Wildlife Society—Western Section (2000: 10 pp.);
- Sierra Nevada Forest Plan Amendment Draft Environmental Impact Statement, on behalf of The Wildlife Society—Western Section (2000: 7 pp.);
- State Water Project Supplemental Water Purchase Program, Draft Program EIR (1997);
- Davis General Plan Update EIR (2000);
- Turn of the Century EIR (1999: 10 pp);
- Proposed termination of Critical Habitat Designation under the Endangered Species Act (Fed. Reg. 64(113): 31871-31874) (1999);
- NOA Draft Addendum to the Final Handbook for Habitat Conservation Planning and Incidental Take Permitting Process, termed the HCP 5-Point Policy Plan (Fed. Reg. 64(45):

11485 - 11490) (1999; 2 pp + attachments);
- Covell Center Project EIR and EIR Supplement (1997).

Position Statements I prepared the following position statements for the Western Section of The Wildlife Society, and one for nearly 200 scientists:

- Recommended that the California Department of Fish and Game prioritize the extermination of the introduced southern water snake in northern California. The Wildlife Society--Western Section (2001);
- Recommended that The Wildlife Society—Western Section appoint or recommend members of the independent scientific review panel for the UC Merced environmental review process (2001);
- Opposed the siting of the University of California's 10th campus on a sensitive vernal pool/grassland complex east of Merced. The Wildlife Society--Western Section (2000);
- Opposed the legalization of ferret ownership in California. The Wildlife Society--Western Section (2000);
- Opposed the Proposed "No Surprises," "Safe Harbor," and "Candidate Conservation Agreement" rules, including permit-shield protection provisions (Fed. Reg. Vol. 62, No. 103, pp. 29091-29098 and No. 113, pp. 32189-32194). This statement was signed by 188 scientists and went to the responsible federal agencies, as well as to the U.S. Senate and House of Representatives.

Posters at Professional Meetings

Leyvas, E. and K. S. Smallwood. 2015. Rehabilitating injured animals to offset and rectify wind project impacts. Conference on Wind Energy and Wildlife Impacts, Berlin, Germany, 9-12 March 2015.

Smallwood, K. S., J. Mount, S. Standish, E. Leyvas, D. Bell, E. Walther, B. Karas. 2015. Integrated detection trials to improve the accuracy of fatality rate estimates at wind projects. Conference on Wind Energy and Wildlife Impacts, Berlin, Germany, 9-12 March 2015.

Smallwood, K. S. and C. G. Thelander. 2005. Lessons learned from five years of avian mortality research in the Altamont Pass WRA. AWEA conference, Denver, May 2005.

Neher, L., L. Wilder, J. Woo, L. Spiegel, D. Yen-Nakafugi, and K.S. Smallwood. 2005. Bird's eye view on California wind. AWEA conference, Denver, May 2005.

Smallwood, K. S., C. G. Thelander and L. Spiegel. 2003. Toward a predictive model of avian fatalities in the Altamont Pass Wind Resource Area. Windpower 2003 Conference and Convention, Austin, Texas.

Smallwood, K.S. and Eva Butler. 2002. Pocket Gopher Response to Yellow Star-thistle Eradication as part of Grassland Restoration at Decommissioned Mather Air Force Base, Sacramento County, California. White Mountain Research Station Open House, Barcroft Station.

Smallwood, K.S. and Michael L. Morrison. 2002. Fresno kangaroo rat (*Dipodomys nitratoides*)

Conservation Research at Resources Management Area 5, Lemoore Naval Air Station. White Mountain Research Station Open House, Barcroft Station.

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.

Presentations at Professional Meetings and Seminars

Repowering the Altamont Pass. Altamont Symposium, The Wildlife Society – Western Section, 5 February 2017.

Developing methods to reduce bird mortality in the Altamont Pass Wind Resource Area, 1999-2007. Altamont Symposium, The Wildlife Society – Western Section, 5 February 2017.

Conservation and recovery of burrowing owls in Santa Clara Valley. Santa Clara Valley Habitat Agency, Newark, California, 3 February 2017.

Mitigation of Raptor Fatalities in the Altamont Pass Wind Resource Area. Raptor Research Foundation Meeting, Sacramento, California, 6 November 2015.

From burrows to behavior: Research and management for burrowing owls in a diverse landscape. California Burrowing Owl Consortium meeting, 24 October 2015, San Jose, California.

The Challenges of repowering. Keynote presentation at Conference on Wind Energy and Wildlife Impacts, Berlin, Germany, 10 March 2015.

Research Highlights Altamont Pass 2011-2015. Scientific Review Committee, Oakland, California, 8 July 2015.

Siting wind turbines to minimize raptor collisions: Altamont Pass Wind Resource Area. US Fish and Wildlife Service Golden Eagle Working Group, Sacramento, California, 8 January 2015.

Evaluation of nest boxes as a burrowing owl conservation strategy. Sacramento Chapter of the Western Section, The Wildlife Society. Sacramento, California, 26 August 2013.

Predicting collision hazard zones to guide repowering of the Altamont Pass. Conference on wind power and environmental impacts. Stockholm, Sweden, 5-7 February 2013.

Impacts of Wind Turbines on Wildlife. California Council for Wildlife Rehabilitators, Yosemite, California, 12 November 2012.

Impacts of Wind Turbines on Birds and Bats. Madrone Audubon Society, Santa Rosa, California, 20 February 2012.

Comparing Wind Turbine Impacts across North America. California Energy Commission Staff Workshop: Reducing the Impacts of Energy Infrastructure on Wildlife, 20 July 2011.

Siting Repowered Wind Turbines to Minimize Raptor Collisions. California Energy Commission Staff Workshop: Reducing the Impacts of Energy Infrastructure on Wildlife, 20 July 2011.

Siting Repowered Wind Turbines to Minimize Raptor Collisions. Alameda County Scientific Review Committee meeting, 17 February 2011

Comparing Wind Turbine Impacts across North America. Conference on Wind energy and Wildlife impacts, Trondheim, Norway, 3 May 2011.

Update on Wildlife Impacts in the Altamont Pass Wind Resource Area. Raptor Symposium, The Wildlife Society—Western Section, Riverside, California, February 2011.

Siting Repowered Wind Turbines to Minimize Raptor Collisions. Raptor Symposium, The Wildlife Society - Western Section, Riverside, California, February 2011.

Wildlife mortality caused by wind turbine collisions. Ecological Society of America, Pittsburgh, Pennsylvania, 6 August 2010.

Map-based repowering and reorganization of a wind farm to minimize burrowing owl fatalities. California burrowing Owl Consortium Meeting, Livermore, California, 6 February 2010.

Environmental barriers to wind power. Getting Real About Renewables: Economic and Environmental Barriers to Biofuels and Wind Energy. A symposium sponsored by the Environmental & Energy Law & Policy Journal, University of Houston Law Center, Houston, 23 February 2007.

Lessons learned about bird collisions with wind turbines in the Altamont Pass and other US wind farms. Meeting with Japan Ministry of the Environment and Japan Ministry of the Economy, Wild Bird Society of Japan, and other NGOs Tokyo, Japan, 9 November 2006.

Lessons learned about bird collisions with wind turbines in the Altamont Pass and other US wind farms. Symposium on bird collisions with wind turbines. Wild Bird Society of Japan, Tokyo, Japan, 4 November 2006.

Responses of Fresno kangaroo rats to habitat improvements in an adaptive management framework. California Society for Ecological Restoration (SERCAL) 13th Annual Conference, UC Santa Barbara, 27 October 2006.

Fatality associations as the basis for predictive models of fatalities in the Altamont Pass Wind Resource Area. EEI/APLIC/PIER Workshop, 2006 Biologist Task Force and Avian Interaction with Electric Facilities Meeting, Pleasanton, California, 28 April 2006.

Burrowing owl burrows and wind turbine collisions in the Altamont Pass Wind Resource Area. The Wildlife Society - Western Section Annual Meeting, Sacramento, California, February 8, 2006.

Mitigation at wind farms. Workshop: Understanding and resolving bird and bat impacts. American Wind Energy Association and Audubon Society. Los Angeles, CA. January 10 and 11, 2006.

Incorporating data from the California Wildlife Habitat Relationships (CWHR) system into an impact assessment tool for birds near wind farms. Shawn Smallwood, Kevin Hunting, Marcus Yee, Linda Spiegel, Monica Parisi. Workshop: Understanding and resolving bird and bat impacts. American Wind Energy Association and Audubon Society. Los Angeles, CA. January 10 and 11, 2006.

Toward indicating threats to birds by California's new wind farms. California Energy Commission, Sacramento, May 26, 2005.

Avian collisions in the Altamont Pass. California Energy Commission, Sacramento, May 26, 2005.

Ecological solutions for avian collisions with wind turbines in the Altamont Pass Wind Resource Area. EPRI Environmental Sector Council, Monterey, California, February 17, 2005.

Ecological solutions for avian collisions with wind turbines in the Altamont Pass Wind Resource Area. The Wildlife Society—Western Section Annual Meeting, Sacramento, California, January 19, 2005.

Associations between avian fatalities and attributes of electric distribution poles in California. The Wildlife Society - Western Section Annual Meeting, Sacramento, California, January 19, 2005.

Minimizing avian mortality in the Altamont Pass Wind Resources Area. UC Davis Wind Energy Collaborative Forum, Palm Springs, California, December 14, 2004.

Selecting electric distribution poles for priority retrofitting to reduce raptor mortality. Raptor Research Foundation Meeting, Bakersfield, California, November 10, 2004.

Responses of Fresno kangaroo rats to habitat improvements in an adaptive management framework. Annual Meeting of the Society for Ecological Restoration, South Lake Tahoe, California, October 16, 2004.

Lessons learned from five years of avian mortality research at the Altamont Pass Wind Resources Area in California. The Wildlife Society Annual Meeting, Calgary, Canada, September 2004.

The ecology and impacts of power generation at Altamont Pass. Sacramento Petroleum Association, Sacramento, California, August 18, 2004.

Burrowing owl mortality in the Altamont Pass Wind Resource Area. California Burrowing Owl Consortium meeting, Hayward, California, February 7, 2004.

Burrowing owl mortality in the Altamont Pass Wind Resource Area. California Burrowing Owl Symposium, Sacramento, November 2, 2003.

Raptor Mortality at the Altamont Pass Wind Resource Area. National Wind Coordinating Committee, Washington, D.C., November 17, 2003.

Raptor Behavior at the Altamont Pass Wind Resource Area. Annual Meeting of the Raptor Research Foundation, Anchorage, Alaska, September, 2003.

Raptor Mortality at the Altamont Pass Wind Resource Area. Annual Meeting of the Raptor Research Foundation, Anchorage, Alaska, September, 2003.

California mountain lions. Ecological & Environmental Issues Seminar, Department of Biology, California State University, Sacramento, November, 2000.

Intra- and inter-turbine string comparison of fatalities to animal burrow densities at Altamont Pass. National Wind Coordinating Committee, Carmel, California, May, 2000.

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 (*Geomyidae*) 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.

Other forms of Participation at Professional Meetings

- Scientific Committee, Conference on Wind energy and Wildlife impacts, Berlin, Germany, March 2015.

- Scientific Committee, Conference on Wind energy and Wildlife impacts, Stockholm, Sweden, February 2013.

- Workshop co-presenter at Birds & Wind Energy Specialist Group (BAWESG) Information sharing week, Bird specialist studies for proposed wind energy facilities in South Africa, Endangered Wildlife Trust, Darling, South Africa, 3-7 October 2011.

- Scientific Committee, Conference on Wind energy and Wildlife impacts, Trondheim, Norway, 2-5 May 2011.

- Chair of Animal Damage Management Session, The Wildlife Society, Annual Meeting, Reno, Nevada, September 26, 2001.

- Chair of Technical Session: Human communities and ecosystem health: Comparing perspectives and making connection. Managing for Ecosystem Health, International Congress on Ecosystem Health, Sacramento, CA August 15-20, 1999.

- Student Awards Committee, Annual Meeting of the Western Section of The Wildlife Society, Riverside, CA, January, 2000.

- Student Mentor, Annual Meeting of the Western Section of The Wildlife Society, Riverside, CA, January, 2000.

Printed Mass Media

Smallwood, K.S., D. Mooney, and M. McGuinness. 2003. We must stop the UCD biolab now. Op-Ed to the Davis Enterprise.

Smallwood, K.S. 2002. Spring Lake threatens Davis. Op-Ed to the Davis Enterprise.

Smallwood, K.S. Summer, 2001. Mitigation of habitation. The Flatlander, Davis, California.

Entrikan, R.K. and K.S. Smallwood. 2000. Measure O: Flawed law would lock in new taxes. Op-Ed to the Davis Enterprise.

Smallwood, K.S. 2000. Davis delegation lobbies Congress for Wildlife conservation. Op-Ed to the Davis Enterprise.

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. The Yolo County HCP. Op-Ed to the Davis Enterprise.

Radio/Television

PBS News Hour,

FOX News, Energy in America: Dead Birds Unintended Consequence of Wind Power Development, August 2011.

KXJZ Capital Public Radio -- Insight (Host Jeffrey Callison). Mountain lion attacks (with guest Professor Richard Coss). 23 April 2009;

KXJZ Capital Public Radio -- Insight (Host Jeffrey Callison). Wind farm Rio Vista Renewable Power. 4 September 2008;

KQED QUEST Episode #111. Bird collisions with wind turbines. 2007;

KDVS Speaking in Tongues (host Ron Glick), Yolo County HCP: 1 hour. December 27, 2001;

KDVS Speaking in Tongues (host Ron Glick), Yolo County HCP: 1 hour. May 3, 2001;

KDVS Speaking in Tongues (host Ron Glick), Yolo County HCP: 1 hour. February 8, 2001;

KDVS Speaking in Tongues (host Ron Glick & Shawn Smallwood), California Energy Crisis: 1 hour. Jan. 25, 2001;

KDVS Speaking in Tongues (host Ron Glick), Headwaters Forest HCP: 1 hour. 1998;

Davis Cable Channel (host Gerald Heffernon), Burrowing owls in Davis: half hour. June, 2000;

Davis Cable Channel (hosted by Davis League of Women Voters), Measure O debate: 1 hour. October, 2000;

KXTV 10, In Your Interest, The Endangered Species Act: half hour. 1997.

Reviews of Journal Papers (Scientific journals for whom I've provided peer review)

Journal	**Journal**
American Naturalist	Journal of Animal Ecology
Journal of Wildlife Management	Western North American Naturalist
Auk	Journal of Raptor Research
Biological Conservation	National Renewable Energy Lab reports
Canadian Journal of Zoology	Oikos
Ecosystem Health	The Prairie Naturalist
Environmental Conservation	Restoration Ecology
Environmental Management	Southwestern Naturalist
Functional Ecology	The Wildlife Society--Western Section Trans.
Journal of Zoology (London)	Proc. Int. Congress on Managing for Ecosystem Health
Journal of Applied Ecology	Transactions in GIS
Ecology	Tropical Ecology
Biological Control	The Condor

Committees

- Scientific Review Committee, Alameda County, Altamont Pass Wind Resource Area
- Ph.D. Thesis Committee, Steve Anderson, University of California, Davis
- MS Thesis Committee, Marcus Yee, California State University, Sacramento

Other Professional Activities or Products

Testified in Federal Court in Denver during 2005 over the fate of radio-nuclides in the soil at Rocky Flats Plant after exposure to burrowing animals. My clients won a judgment of $553,000,000. I have also testified in many other cases of litigation under CEQA, NEPA, the Warren-Alquist Act, and other environmental laws. My clients won most of the cases for which I testified.

Testified before Environmental Review Tribunals in Ontario, Canada regarding proposed White Pines and Amherst Island Wind Energy projects.

Testified in Skamania County Hearing in 2009 on the potential impacts of zoning the County for development of wind farms and hazardous waste facilities.

Testified in deposition in 2007 in the case of O'Dell et al. vs. FPL Energy in Houston, Texas.

Testified in Klickitat County Hearing in 2006 on the potential impacts of the Windy Point Wind Farm.

Memberships in Professional Societies

The Wildlife Society
Raptor Research Foundation

Honors and Awards

Fulbright Research Fellowship to Indonesia, 1987
J.G. Boswell Full Academic Scholarship, 1981 college of choice
Certificate of Appreciation, The Wildlife Society—Western Section, 2000, 2001
Northern California Athletic Association Most Valuable Cross Country Runner, 1984
American Legion Award, Corcoran High School, 1981, and John Muir Junior High, 1977
CIF Section Champion, Cross Country in 1978
CIF Section Champion, Track & Field 2 mile run in 1981
National Junior Record, 20 kilometer run, 1982
National Age Group Record, 1500 meter run, 1978

Community Activities

District 64 Little League Umpire, 2003-2007
Dixon Little League Umpire, 2006-07
Davis Little League Chief Umpire and Board member, 2004-2005
Davis Little League Safety Officer, 2004-2005
Davis Little League Certified Umpire, 2002-2004
Davis Little League Scorekeeper, 2002
Davis Visioning Group member
Petitioner for Writ of Mandate under the California Environmental Quality Act against City of Woodland decision to approve the Spring Lake Specific Plan, 2002
Served on campaign committees for City Council candidates

Representative Clients/Funders

Law Offices of Stephan C. Volker
Blum Collins, LLP
Eric K. Gillespie Professional Corporation
Law Offices of Berger & Montague
Lozeau | Drury LLP
Law Offices of Roy Haber
Law Offices of Edward MacDonald
Law Office of John Gabrielli
Law Office of Bill Kopper
Law Office of Donald B. Mooney
Law Office of Veneruso & Moncharsh
Law Office of Steven Thompson
Law Office of Brian Gaffney
California Wildlife Federation
Defenders of Wildlife
Sierra Club
National Endangered Species Network
Spirit of the Sage Council
The Humane Society
Hagens Berman LLP
Environmental Protection Information Center
Goldberg, Kamin & Garvin, Attorneys at Law
Californians for Renewable Energy (CARE)
Seatuck Environmental Association
Friends of the Columbia Gorge, Inc.
Save Our Scenic Area
Alliance to Protect Nantucket Sound
Friends of the Swainson's Hawk
Alameda Creek Alliance
Center for Biological Diversity
California Native Plant Society
Endangered Wildlife Trust
and BirdLife South Africa
AquAlliance
Oregon Natural Desert Association
Save Our Sound
G3 Energy and Pattern Energy
Emerald Farms
Pacific Gas & Electric Co.
Southern California Edison Co.
Georgia-Pacific Timber Co.
Northern Territories Inc.
David Magney Environmental Consulting
Wildlife History Foundation
NextEra Energy Resources, LLC
Ogin, Inc.
EDF Renewables
National Renewable Energy Lab
Altamont Winds LLC
Salka Energy
Comstocks Business (magazine)
BioResource Consultants
Tierra Data
Black and Veatch
Terry Preston, Wildlife Ecology Research Center
EcoStat, Inc.
US Navy
US Department of Agriculture
US Forest Service
US Fish & Wildlife Service
US Department of Justice
California Energy Commission
California Office of the Attorney General
California Department of Fish & Wildlife
California Department of Transportation
California Department of Forestry
California Department of Food & Agriculture
Ventura County Counsel
County of Yolo
Tahoe Regional Planning Agency
Sustainable Agriculture Research & Education Program
Sacramento-Yolo Mosquito and Vector Control District
East Bay Regional Park District
County of Alameda
Don & LaNelle Silverstien
Seventh Day Adventist Church
Escuela de la Raza Unida
Susan Pelican and Howard Beeman
Residents Against Inconsistent Development, Inc.
Bob Sarvey
Mike Boyd
Hillcroft Neighborhood Fund
Joint Labor Management Committee, Retail Food Industry
Lisa Rocca
Kevin Jackson
Dawn Stover and Jay Letto
Nancy Havassy
Catherine Portman (for Brenda Cedarblade)
Ventus Environmental Solutions, Inc.
Panorama Environmental, Inc.
Adams Broadwell Professional Corporation

Representative special-status species experience

Common name	Species name	Description
Field experience		
California red-legged frog	*Rana aurora draytonii*	Protocol searches; Many detections
Foothill yellow-legged frog	*Rana boylii*	Presence surveys; Many detections
Western spadefoot	*Spea hammondii*	Presence surveys; Few detections
California tiger salamander	*Ambystoma californiense*	Protocol searches; Many detections
Coast range newt	*Taricha torosa torosa*	Searches and multiple detections
Blunt-nosed leopard lizard	*Gambelia sila*	Detected in San Luis Obispo County
California horned lizard	*Phrynosoma coronatum frontale*	Searches; Many detections
Western pond turtle	*Clemmys marmorata*	Searches; Many detections
San Joaquin kit fox	*Vulpes macrotis mutica*	Protocol searches; detections
Sumatran tiger	*Panthera tigris*	Track surveys in Sumatra
Mountain lion	*Puma concolor californicus*	Research and publications
Point Arena mountain beaver	*Aplodontia rufa nigra*	Remote camera operation
Giant kangaroo rat	*Dipodomys ingens*	Detected in Cholame Valley
San Joaquin kangaroo rat	*Dipodomys nitratoides*	Monitoring & habitat restoration
Monterey dusky-footed woodrat	*Neotoma fuscipes luciana*	Non-target captures and mapping of dens
Salt marsh harvest mouse	*Reithrodontomys raviventris*	Habitat assessment, monitoring
Salinas harvest mouse	*Reithrodontomys megalotus distichlus*	Captures; habitat assessment
Bats		Thermal imaging surveys
California clapper rail	*Rallus longirostris*	Surveys and detections
Golden eagle	*Aquila chrysaetos*	Numerical & behavioral surveys
Swainson's hawk	*Buteo swainsoni*	Numerical & behavioral surveys
Northern harrier	*Circus cyaeneus*	Numerical & behavioral surveys
White-tailed kite	*Elanus leucurus*	Numerical & behavioral surveys
Loggerhead shrike	*Lanius ludovicianus*	Large area surveys
Least Bell's vireo	*Vireo bellii pusillus*	Detected in Monterey County
Willow flycatcher	*Empidonax traillii extimus*	Research at Sierra Nevada breeding sites
Burrowing owl	*Athene cunicularia hypugia*	Numerical & behavioral surveys
Valley elderberry longhorn beetle	*Desmocerus californicus dimorphus*	Monitored success of relocation and habitat restoration
Analytical		
Arroyo southwestern toad	*Bufo microscaphus californicus*	Research and report.
Giant garter snake	*Thamnophis gigas*	Research and publication
Northern goshawk	*Accipiter gentilis*	Research and publication
Northern spotted owl	*Strix occidentalis*	Research and reports
Alameda whipsnake	*Masticophis lateralis euryxanthus*	Expert testimony