Appendix B

Notice of Preparation Comment Letters

State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
South Coast Region
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GAVIN NEWSOM, Governor
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April 7, 2021

Ms. Lorrie Bradley
Environmental Planner
County of San Diego, Department of Parks and Recreation
Lead/Public Agency
5500 Overland Avenue, Suite 410
San Diego, CA 92123
Lorrie.Bradley@sdcounty.ca.gov

Subject: Alpine County Park Project (PROJECT), Notice of preparation (NOP) of a Draft Environmental Report (DEIR), SCH #2021030196

Dear Ms. Bradley:

The California Department of Fish and Wildlife (CDFW) received a NOP of a DEIR from the County of San Diego (County) Department of Parks and Recreation (DPR) for the Project pursuant the California Environmental Quality Act (CEQA) and CEQA Guidelines.

Thank you for the opportunity to provide comments and recommendations regarding the activities involved in the Alpine County Park Project that may affect California fish and wildlife. Likewise, we appreciate the opportunity to provide comments regarding those aspects of the Project that CDFW, by law, may be required to carry out or approve through the exercise of its own regulatory authority under the Fish and Game Code.

CDFW Role

CDFW is California's Trustee Agency for fish and wildlife resources and holds those resources in trust by statute for all the people of the State [Fish & G. Code, §§ 711.7, subdivision (a) & 1802; Pub. Resources Code, § 21070; CEQA Guidelines, § 15386, subdivision (a)]. CDFW, in its trustee capacity, has jurisdiction over the conservation, protection, and management of fish, wildlife, native plants, and habitat necessary for biologically sustainable populations of those species (Id., § 1802). Similarly, for purposes of CEQA, CDFW is charged by law to provide, as available, biological expertise during public agency environmental review efforts, focusing specifically on projects and related activities that have the potential to adversely affect state fish and wildlife resources.

CDFW is also submitting comments as a Responsible Agency under CEQA (Pub. Resources Code, § 21069; CEQA Guidelines, § 15381). CDFW may need to exercise regulatory authority as provided by the Fish and Game Code, including lake and streambed alteration regulatory authority (Fish & G. Code, § 1600 et seq.). Likewise, to the extent implementation of the Project as proposed may result in "take" (see Fish & G. Code, § 2050) of any species protected under the California Endangered Species Act (CESA; Fish & G. Code, § 2050 et seq.) or the Native

Plant Protection Act (NPPA; Fish & G. Code, §1900 et seq.), CDFW recommends the Project proponent obtain appropriate authorization under the Fish and Game Code.

CDFW also administers the Natural Community Conservation Planning (NCCP) program, a California regional habitat conservation planning program. The County participates in the NCCP program by implementing its approved Subarea Plan (SAP) under the County Multiple Species Conservation Plan (MSCP). The Project site is located with the boundaries of the County's approved MSCP covering southwestern San Diego County. Although the MSCP is permitted under both the California NCCP and federal Habitat Conservation Plan (HCP) programs, the MSCP did not provide take coverage for the Quino checkerspot butterfly (*Euphydryas editha quino*), a federal endangered species that has been identified onsite. Impacts are therefore being addressed by the U.S. Fish and Wildlife Service (USFWS) under a separate HCP.

PROJECT DESCRIPTION SUMMARY

Proponent: County DPR

Objective: The Project site is in the area covered by the Alpine Community plan. The site is subject to the General Plan Rural Lands Regional Category, with an Open Space-Conservation land use designation in the western portion of the property and a Semi-Rural Residential land use designation in the eastern portion. The Project site encompasses 98 acres. Twenty-five acres will be developed and turned into an active park and the 73 acres that will not be developed will be designated as open space and managed as part of the MSCP Preserve. The 25-acre active park will include: multi-use turf areas, baseball field, all-wheel area, bike skills area, recreational courts (i.e., basketball, pickleball, game table plaza), fitness stations, leash-free dog area, restroom facilities, administrative facility/ranger station, equestrian staging with a corral, nature play area, community garden, volunteer pad, picnic areas with shade structures, picnic tables, game table plaza, and trails. Included in the Project boundary will be a parking area with 250-275 single vehicle spaces. There will be two entrances to the parking area located on South Grade Road. The Project site will be open to the public from sunrise to sunset. Dogs are allowed on leashes in the Project boundaries and off-leash in the designated dog area. As stated above, the 73 acres that will not be developed will be called the Alpine Park Preserve (Preserve), and monitored and managed by the County. This management will include maintenance of one mile of existing trail and closure of informal use trails. The HCP will also include restoration and habitat enhancement for the Quino checkerspot butterfly.

Location: The Project site is in eastern San Diego County, one mile south of Interstate 8, and approximately one mile south of the center of the town of Alpine. Alpine is an unincorporated community in the eastern portion of the County and is approximately 25 miles east of downtown San Diego. The Project site is north of South Grade Road, east of Tavern Road, and adjacent to the Backcountry Land Trust's (BCLT) Wright's Field Preserve. Residential and rural communities surround the 98-acre site.

COMMENTS AND RECOMMENDATIONS

CDFW offers the following comments and recommendations to assist the County in adequately identifying and/or mitigating the Project's significant, or potentially significant, direct and indirect impacts on fish and wildlife (biological) resources.

Specific Comments

1) Consider Alternative Location(s). Due to the presence of highly sensitive habitats (clay soils, native grassland) and species on and/or adjacent to conserved areas of Wright's Field, CDFW recommends that the forthcoming DEIR include an alternative location or locations that would meet the needs of the community yet avoid or minimize impacts while not reducing the remaining acreage of the large block of habitat encompassing the Wright's Field conservation area.

2) Biological Baseline Assessment. CDFW recommends that the DEIR provide a complete assessment and impact analysis of the flora and fauna within and adjacent to the Project site, with emphasis upon identifying endangered, threatened, sensitive, regionally and locally unique species, including any Covered Species under the County's approved MSCP, and sensitive habitats. Impact analysis will aid in determining any direct, indirect, and cumulative biological impacts, as well as specific mitigation or avoidance measures necessary to offset those impacts. CDFW recommends avoiding or minimizing impacts to any sensitive natural communities found on or adjacent to the Project. The DEIR should include the following information:

    a) Information on the regional setting that is critical to an assessment of environmental impacts, with special emphasis on resources that are rare or unique to the region [CEQA Guidelines, § 15125(c)]. The DEIR should include measures to fully avoid and otherwise protect Sensitive Natural Communities from Project-related impacts. Project implementation may result in impacts to rare or endangered plants or plant communities that have been recorded adjacent to the Project vicinity. CDFW considers these communities as threatened habitats having both regional and local significance. Plant communities, alliances, and associations with a state-wide ranking of S1, S2, S3, and S4 should be considered sensitive and declining at the local and regional level. These ranks can be obtained by visiting https://www.wildlife.ca.gov/Data/VegCAMP/Natural-Communities#sensitive%20natural%20communities;

    b) A complete floristic assessment within and adjacent to the Project area, with particular emphasis upon identifying endangered, threatened, sensitive, and locally unique species and sensitive habitats. This should include a thorough, recent, floristic-based assessment of special status plants and natural communities.

    c) A complete, recent, assessment of the biological resources associated with each habitat type onsite and within adjacent areas that could also be affected by the Project. CDFW's California Natural Diversity Database (CNDDB) should be reviewed to obtain current information on any previously reported sensitive species and habitat. CDFW recommends that CNDDB Field Survey Forms be completed and submitted to CNDDB to document survey results. Online forms can be obtained and submitted at http://www.dfg.ca.gov/biogeodata/cnddb/submitting_data_to_cnddb.asp;

    d) CNDDB indicates the occurrence of several special status species within the Project vicinity. The DEIR should have a complete, recent, assessment of rare, threatened, and endangered, and other sensitive species onsite and within the area of potential

effect, including California Species of Special Concern and California Fully Protected Species (Fish & G. Code, §§ 3511, 4700, 5050 and 5515). Species to be addressed should include all those which meet the CEQA definition of endangered, rare or threatened species (CEQA Guidelines, § 15380). Seasonal variations in use of the Project area should also be addressed. Focused species-specific surveys, conducted at the appropriate time of year and time of day when the sensitive species are active or otherwise identifiable, are required. Acceptable species-specific survey procedures should be developed in consultation with CDFW and the USFWS; and,

e) A recent wildlife and rare plant survey. CDFW generally considers biological field assessments for wildlife to be valid for a one-year period, and assessments for rare plants may be considered valid for a period of up to three years as long as there was not a prevailing drought during the time of the botanical survey. Some aspects of the proposed Project may warrant periodic updated surveys for certain sensitive taxa, particularly if build out could occur over a protracted time frame, or in phases.

3) Management Plan. A site Resource Management Plan (RMP) for the 73-acre Preserve should be completed before any trails are opened to the public. A discussion is needed on the impacts of the designated trails that will be located throughout the Preserve and the cumulative impacts that will result from an increase in human activity. The RMP will need to address how these impacts will be monitored and managed in the Preserve.

4) Listed Species and California Species of Special Concern (SSC). CNDDB indicates that State rare (SR), CDFW Watch List (WL), CDFW fully protected (FP), SSC, or California Endangered Species Act (CESA)-listed (i.e., State Endangered (SE) or State Threatened (ST)) or federal Endangered Species Act (ESA)-listed (i.e., federal Endangered) (FE) or federal Threatened (FT) or a candidate for federal listing (FC)) are known in and adjacent to the Project area. Also indicated below are species which are covered by the South County (i.e., existing/approved) MSCP (SC) and species which are preliminarily proposed for coverage under the forthcoming East County MSCP (EC)).

   a) Sensitive plant species known in the Project area include (but are not limited to): Cuyamaca larkspur (*Delphinium hesperium* ssp. *cuyamacae*, SR); Dehesa beargrass (*Nolina interrata*, SE, SC); Dunn's mariposa lily (*Calochortus dunnii*, SR, SC); Encinitas baccharis (*Baccharis vanessae*, FT, SE, CS); Gander's ragwort (*Packera ganderi*, SR, EC); Mexican flannelbush (*Fremontodendron mexicanum*, FE, SR); and San Diego thorn-mint (*Acanthomintha ilicifolia*, FT, SE, SC).

   b) Sensitive amphibians and reptiles include (but are not limited to): arroyo toad (*Anaxyrus californicus,* FE, SSC, SC, EC); Blainville's horned lizard (*Phrynosoma blainvillii,* SSC, EC, SC); California glossy snake (*Arizona elegans occidentalis*, SSC); coast patch-nosed snake (*Salvadora hexalepis virgultea*, SSC, EC); coast range newt (*Taricha torosa*, SSC, EC); coastal whiptail (*Aspidoscelis tigris stejnegeri*, SSC); Coronado skink (*Plestiodon skiltonianus interparietalis*, WL, EC); orange-throated whiptail (*Aspidoscelis hyperythra beldingi*, WL, EC, SC); red-diamond rattlesnake (*Crotalus ruber*, SSC, EC); silvery legless lizard (*Anniella pulchra,* SSC, EC); southwestern pond turtle (*Actinemys pallida*, SSC, EC, SC); two-striped gartersnake (*Thamnophis hammondii*, SSC, EC); and western spadefoot (*Spea hammondii*, SSC, EC).

c) Sensitive bird species include but are not limited to: Bell's sparrow (*Artemisiospiza belli*, WL); coastal cactus wren (*Campylorhynchus brunneicapillus sandiegensis,* SSC, EC, SC); coastal California gnatcatcher (*Polioptila californica,* FT, SSC, SC); Cooper's hawk (*Accipiter cooperii*, WL, SC); golden eagle (*Aquila chrysaetos*, WL, FP, EC, SC); least Bell's vireo (*Vireo bellii pusillus,* FE, SE, EC, SC); southern California rufous-crowned sparrow (*Aimophila ruficeps canescens,* WL, EC, SC); southwestern willow flycatcher (*Empidonax trailii extimus,* FE, SE, EC, SC); Swainson's hawk (*Buteo swainsoni*, ST, SC); tricolored blackbird (*Agelaius tricolor*, ST, EC, SC); and yellow-breasted chat (*Icteria virens*, SSC).

d) Sensitive invertebrates include (but are not limited to): Hermes copper butterfly (*Lycaena hermes*, FC, EC) and Quino checkerspot butterfly (FE, EC).

e) Sensitive mammals include but are not limited to: American badger (*Taxidea taxus*, SSC, SC); Dulzura pocket mouse (*Chaetodipus californicus femoralis,* SSC); northwestern San Diego pocket mouse (*Chaetodipus fallax*, SSC); San Diego desert woodrat (*Neotoma lepida intermedia*, SSC); San Diego black-tailed jackrabbit (*Lepus californicus bennettii,* SSC, EC); pallid bat (*Antrozous pallidus*, SSC, EC); pocketed free-tailed bat (*Nyctinomops femorosaccus*, SSC); big free-tailed bat (*Nyctinomops macrotis*, SSC); Townsend's big-eared bat (*Corynorhinus townsendii*, SSC, EC); western mastiff bat (*Eumops perotis californicus*, SSC); western red bat (*Lasiurus blossevillii*, SSC); and western yellow bat (*Lasiurus xanthinus*, SSC).

5) Quino Checkerspot Butterfly. The Project Description indicates the presence of Quino checkerspot butterfly onsite. This butterfly is federally endangered and a County Group 1 species. This species is found only in western Riverside County, southern San Diego County, and northern Baja California, Mexico (USFWS 2003). The DEIR should make provisions to avoid the occupied area: however, further discussion should be included in the final document to address indirect impacts to the species.

a) Direct impacts to Quino checkerspot butterfly could result from Project construction and activities (e.g., equipment staging, mobilization, and grading); ground disturbance; vegetation clearing; and trampling or crushing from construction equipment, vehicles, and foot traffic. Indirect impacts could result from fugitive construction dust coating foraging habitat, and other edge effects associated with landscaping and fencing.

b) CEQA provides protection for CESA- and ESA-listed species. Quino checkerspot butterfly is federally endangered and CDFW considers impacts to federally threatened species a significant direct and cumulative adverse effect without implementing appropriate avoidance and/or mitigation measures.

6) Vernal pools. The Project site is adjacent to the BCLT Wright's Field Preserve which has vernal pools present. The Project Site has species present that are associated with vernal pools such as western spadefoot and contains high levels of clay soil which are known to support vernal pools and sensitive species. Vernal pools are considered a rare resource, as it is estimated over 95% of vernal pools in California have been destroyed (USFWS 1998). CDFW considers the loss of these pool complexes to be regionally and biologically

significant. To fully avoid impacts to vernal pools and depressions, the entire sub-watershed that supports the hydrology of the pool/depression should be avoided and conserved.

7) Biological Direct, Indirect, and Cumulative Impacts. Due to the proximity of the Project site to the Alpine Park Preserve and BCLT's Wright's Field Preserve, it is essential to understand how the open space and biological diversity within it may be impacted by Project activities. CDFW recommends providing a thorough discussion of direct, indirect, and cumulative impacts expected to adversely affect biological resources, with specific measures to offset such impacts. The following should be addressed in the DEIR:

    a) A discussion regarding indirect Project impacts on biological resources, including resources in nearby public lands, open space, adjacent natural habitats, riparian ecosystems, and any designated and/or proposed or existing reserve lands (e.g., preserve lands associated with an NCCP (NCCP, Fish & G. Code, § 2800 et. seq.). Impacts on, and maintenance of, wildlife corridor/movement areas, including access to undisturbed habitats in adjacent areas, should be fully evaluated in the DEIR;

    b) A discussion of potential adverse impacts from lighting, noise, temporary and permanent human activity, and exotic species and identification of any mitigation measures;

    c) A discussion on Project-related changes on drainage patterns downstream of the Project site; the volume, velocity, and frequency of existing and post-Project surface flows; polluted runoff; soil erosion and/or sedimentation in streams and water bodies; and post-Project fate of runoff from the Project site. The Project includes plans for an underground parking structure; therefore, the discussion should also address the proximity of the extraction activities to the water table, whether dewatering would be necessary, and the potential impacts on the habitat (if any) supported by the groundwater. Mitigation measures proposed to alleviate such Project impacts should be included;

    d) An analysis of impacts from land use designations and zoning located nearby or adjacent to natural areas that may inadvertently contribute to wildlife-human interactions. A discussion of possible conflicts and mitigation measures to reduce these conflicts should be included in the DEIR; and,

    e) A cumulative effects analysis, as described under CEQA Guidelines section 15130. General and specific plans, as well as past, present, and anticipated future projects, should be analyzed relative to their impacts on similar plant communities and wildlife habitats.

8) Sensitive Bird Species. The Project plans indicate that existing undeveloped land will be developed for the 25-acre park. A review CNDDB indicates occurrences of special status bird species the Project vicinity. Project activities occurring during the breeding season of nesting birds could result in the incidental loss of fertile eggs, or nestlings, or otherwise lead to nest abandonment in habitat directly adjacent to the Project boundary. The Project could also lead to the loss of foraging habitat for sensitive bird species.

a) CDFW recommends that measures be taken to avoid Project impacts to nesting birds. Migratory nongame native bird species are protected by international treaty under the Federal Migratory Bird Treaty Act (MBTA) of 1918 (Code of Federal Regulations, Title 50, § 10.13). Sections 3503, 3503.5, and 3513 of the California Fish and Game Code prohibit take of all birds and their active nests including raptors and other migratory nongame birds (as listed under the MBTA).

b) Project activities including but not limited to staging and disturbances to native and nonnative vegetation, structures, and substrates should occur outside of the avian breeding season which generally runs from February 15 through August 31 (as early as January 1 for some raptors) to avoid take of birds or their eggs. If avoidance of the avian breeding season is not feasible, CDFW recommends surveys by a qualified biologist with experience in conducting breeding bird surveys to detect protected native birds occurring in suitable nesting habitat that is to be disturbed and (as access to adjacent areas allows) any other such habitat within 300 feet of the disturbance area (within 500 feet for raptors). Project personnel, including all contractors working onsite, should be instructed on the sensitivity of the area. Reductions in the nest buffer distance may be appropriate depending on the avian species involved, ambient levels of human activity, screening vegetation, or possibly other factors.

9) Landscaping. The Project Description includes landscaped areas and a community garden on the Project site. Habitat loss and invasive plants are a leading cause of native biodiversity loss. CDFW recommends that the DEIR also stipulate that no invasive plant material shall be used. Furthermore, we recommend using native, locally appropriate plant species for landscaping on the Project site. A list of invasive/exotic plants that should be avoided as well as suggestions for suitable landscape plants can be found at https://www.cal-ipc.org/solutions/prevention/landscaping/.

General Comments

1) Project Description and Alternatives. To enable CDFW to adequately review and comment on the Project from the standpoint of the protection of plants, fish, and wildlife, we recommend the following information be included in the DEIR:

a) A complete discussion of the purpose and need for, and description of, the Project, including all staging areas and access routes to the construction and staging areas; and,

b) A range of feasible alternatives to Project component location and design features to ensure that alternatives to the proposed Project are fully considered and evaluated. The alternatives should avoid or otherwise minimize direct and indirect impacts to sensitive biological resources and wildlife movement areas.

2) Compensatory Mitigation. The DEIR should include mitigation measures for adverse Project-related impacts to sensitive plants, animals, and habitats. Mitigation measures should emphasize avoidance and reduction of Project impacts. For unavoidable impacts, onsite habitat restoration or enhancement should be discussed in detail. If onsite mitigation is not feasible or would not be biologically viable and therefore would not adequately mitigate the loss of biological functions and values, offsite mitigation through habitat creation and/or

acquisition and preservation in perpetuity should be addressed. Areas proposed as mitigation lands should be protected in perpetuity with a conservation easement, financial assurance, and dedicated to a qualified entity for long-term management and monitoring. Under Government Code section 65967, the Lead Agency must exercise due diligence in reviewing the qualifications of a governmental entity, special district, or non-profit organization to effectively manage and steward land, water, or natural resources on mitigation lands that it approves.

3) Long-term Management of Mitigation Lands. For proposed preservation and/or restoration, the DEIR should include measures to protect the targeted habitat values from direct and indirect negative impacts in perpetuity. The objective should be to offset the Project-induced qualitative and quantitative losses of wildlife habitat values. Issues that should be addressed include (but are not limited to) restrictions on access, proposed land dedications, monitoring and management programs, control of illegal dumping, water pollution, and increased human intrusion. An appropriate non-wasting endowment should be set aside to provide for long-term management of mitigation lands.

ENVIRONMENTAL DATA

CEQA requires that information developed in environmental impact reports and negative declarations be incorporated into a data base which may be used to make subsequent or supplemental environmental determinations. (Pub. Resources Code, § 21003, subd. (e).) Accordingly, please report any special status species and natural communities detected during Project surveys to the California Natural Diversity Database (CNDDB). The CNNDB field survey form can be found at the following link: http://www.dfg.ca.gov/biogeodata/cnddb/pdfs/CNDDB_FieldSurveyForm.pdf. The completed form can be mailed electronically to CNDDB at the following email address: CNDDB@wildlife.ca.gov. The types of information reported to CNDDB can be found at the following link: http://www.dfg.ca.gov/biogeodata/cnddb/plants_and_animals.asp.

FILING FEES

The Project, as proposed, would have an impact on fish and/or wildlife, and assessment of filing fees is necessary. Fees are payable upon filing of the Notice of Determination by the Lead Agency and serve to help defray the cost of environmental review by CDFW. Payment of the fee is required in order for the underlying project approval to be operative, vested, and final. (Cal. Code Regs, tit. 14, § 753.5; Fish & G. Code, § 711.4; Pub. Resources Code, § 21089.)

CONCLUSION

CDFW appreciates the opportunity to comment on the NOP to assist the County in identifying and mitigating Project impacts on biological resources.

Questions regarding this letter or further coordination should be directed to Emily Gray, Environmental Scientist, at Emily.Gray@wildlife.ca.gov.

Sincerely,

DocuSigned by:
David Mayer
D700B4520375406...

David Mayer
Environmental Program Manager I
South Coast Region

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References

California Department of Fish and Wildlife. 2020. California Natural Diversity Database. Available from: https://wildlife.ca.gov/Data/CNDDB.

California Department of Fish and Wildlife. 2020. Lake and Streambed Alteration Program. Available from: https://wildlife.ca.gov/Conservation/LSA.

Cowardin et al. 1970. Classification of Wetlands and Deepwater Habitats of the United States.

San Diego (1998). San Diego Multiple Species Conservation Program, Plan. Final MSCP Program Plan, August 1998.

Sawyer, J.O., T. Keeler-Wolf, and J.M. Evens. 2008. A Manual of California Vegetation, 2nd ed. ISBN 978-0-943460-49-9.

U.S. Fish and Wildlife Service. 1998. Vernal Pools of Southern California Recovery Plan. U.S. Fish and Wildlife Service, Portland, Oregon. 113 pp.

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April 6, 2021

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5500 Overland Avenue, Suite 410
San Diego, CA 92123
By email to CountyParksCEQA@sdcounty.ca.gov and lorrie.bradley@sdcounty.ca.gov.

RE: Notice of Preparation of a Draft Environmental Impact Report on the Alpine County Park Project

Dear Ms. Bradley,

Thank you for the opportunity to provide information for the Notice of Preparation ("NOP") of the Environmental Impact Report ("EIR") on the Alpine County Park Project ("Project"). The San Diego Chapter of the California Native Plant Society, Environmental Center of San Diego, and Preserve Wild Santee all work to protect California's natural heritage and preserve it for future generations. We promote sound science as the backbone of effective natural areas protection. We work closely with decision-makers, scientists, and local planners to advocate for well informed and environmentally friendly policies, regulations, and land management practices.

There are also two CEQA topics, energy and tribal cultural issues, must be addressed, although they were not identified in the NOP. First, energy efficiency cannot be separated from climate change in the proposed design, so both need to be analyzed for their different impacts. Second, since the Wright's Field area has both recent historical and tribal use, impacts to both cultural and tribal cultural resources must be analyzed.

We have specific comments on biological issues, climate change, and wildfire that need to be addressed in the NOP. These are detailed below. Finally, we strongly urge County Parks to analyze a smaller, less impactful, sustainable park design as an alternative.

Biology
First, we urge the Project DEIR to use reasonably current surveys of the site, surveys conducted during a rainy year in appropriate seasons to find sensitive species. Second, we urge the County

to include impacts to Wright's Field in the DEIR. The issue is the impacts to native plants, animals, vegetation communities, and wetlands as a result of the proposed Project increasing biking, hiking, and horseback riding on both Wright's Field and the project site. Since the project is directly connected to the Wright's Field trail system and will have 260-285 parking spaces, it is obvious that construction of the proposed project will increase the level of human recreation on Wright's Field Preserve. Concerns are ever-increasing about recreational impacts to sensitive biological resources on the conserved lands within San Diego County, including in many reserves, such as Carlsbad Highlands Ecological Reserve, Sycamore Canyon Preserve-Gooden Ranch (particularly with unauthorized use of a highway wildlife underpass), Del Mar Mesa Ecological Reserve, and others. There is a growing body of research about recreational impacts to animals and plants. Research on such impacts is termed recreation ecology. This is analogous to *conservation biology*, which also should be a foundational science for work on this project.

We have included a copy of a recent California Fish and Wildlife Journal issue dedicated to recreation ecology to help you get up to speed. Please include it in the written record, and make sure that the biologists and planners working on the biology section of the DEIR read it. It will help their efforts.

Please analyze recreation impacts in the project EIR, and either avoid significant adverse impacts, or at worst, mitigate them below the level of significance. Any proposed mitigation should reflect that knowing how to mitigate for recreation-related indirect impacts to biological resources requires knowing exactly what those impacts are and when they occur. At a minimum, appropriate impact analyses will require up-to-date surveys of both the proposed project site and Wright's Field, scientifically sound modeling of the present and proposed future trails and recreation, and data on how the presence of humans both with and without their dogs, horses, and other animals affects plants and animals; some such data already exists. Adverse biological direct and indirect impacts can arise from most recreational activities, including: hikers, bikers, and horses and their riders simply using a trail; people allowing dogs to chase animals; and people and/or dogs trampling in vernal pools or on sensitive plants and small animals. Indirect recreation-related adverse impacts include the introduction of weed seeds by mountain bikers and equestrians, and detrimental changes to wildlife involving behavior (e.g., vigilance, foraging, hunting), reproduction, growth, immune system function, levels of stress hormones, the survival of individual animals, and ultimately the persistence of wildlife populations and communities.

Second, the Alpine Community Plan update, which was prepared by the County, states, on page 2.12-3: "The Alpine CPA also includes one preserve, Wright's Field. The purpose of preserves is to maintain community character and protect biological, cultural, and historical resources, while making these resources available for *limited* public recreational opportunities. Some preserves may also provide interpretive and educational amenities, *although public access may be limited according to the sensitivity of the resources*…." (emphases added). Please analyze, in detail, how the proposed project and all alternatives comply with this part of the Community Plan Update.

Third, there are issues with sensitive and listed species. Please insure that the video that substituted for a Scoping Meeting (e.g. https://www.youtube.com/watch?v=xyKiPTawDsQ) is

included in the official record for the project. Since there is no paper trail from a meeting, it is the only evidence that any attempt was made to satisfy the CEQA requirement for a Scoping Meeting. In the video at 6:28, reference was made that the Project intends to "avoid impacts" to Engelmann oaks (*Quercus engelmannii*, CRPR List 4) and to "minimize impacts" to the federally endangered Quino checkerspot butterfly (*Euphydryas editha quino*).

While protection of the oaks is appreciated, there is no legal requirement for it. There is definitely a legal requirement to protect the Quino checkerspot, to the point where the County is currently involved in several lawsuits over plans that harm it. Please redesign the proposed project to *AVOID IMPACTS* to the Quino Checkerspot, rather than simply minimize them. Harming an endangered species in the name of recreation would be a terrible black eye for County Parks, and for the County as a whole.

Climate change impacts

In the climate change section, please include not just construction and traffic impacts, but impacts from park site maintenance, upgrades, and reconstruction. These are a serious issue, because the county plans to go carbon neutral by 2035, while the state of California plans to go carbon neutral by 2045. A park that cannot be maintained due to emissions constraints is not worth building. As part of the design process, estimate the lifespan of each and all of the amenities installed, along with the maintenance requirements and their expected lifespan. Then create a timeline showing carbon annual carbon emissions from routine maintenance and when each amenity will require major repairs or replacement. To avoid unmitigated impacts, the project needs to be carbon neutral by 2035 and to stay that way for the indefinite future thereafter. Avoiding emissions is the simplest way to avoid and mitigate impacts, since there are few ways to mitigate emissions onsite or offsite in the County.

Second, please do not put solar panels and trees close together, as they shade each other. Also, please only put solar panels where they get unobstructed access to the south-facing and/or west-facing sky. These compass directions are necessary for solar panels to work in San Diego. East-facing solar panels are unproductive due to morning cloud cover, and north-facing panels are unproductive in all conditions. The reason for this comment is that the project design (video, at 3:54) specifies "photovoltaic carports." Looking at the attached figure, the carports will line a north-south running road that gradually curves to the southwest, and is bordered by trees. This is a distinctly suboptimal configuration, as either the trees will shade the panels, or the panels will shade the trees.

Please rethink the addition of solar carports. If they are installed, provide a good estimate of how much electricity they will produce at different times of the year, and how much shading is expected from the panels shading each other, trees shading the panels, and panels shading the trees. Remember that the panels provide electricity, while the trees provide carbon sequestration, but both cannot use the same patch of sunlight.

If the County desires to have a solar-powered park, please provide a project alternative that starts from this premise and designs the park to accommodate both solar powered facilities and carbon sequestration in planted trees. Only then design the rest of the facilities around these constraints.

Slapping a few solar panels on a project not designed for this power source is minimally useful. Around 20 standard-sized solar panels with good southern exposure and no shading from trees are necessary to charge one electric car once per week.[1] How many such panels could be installed on the proposed project?

Wildfire

Wildfire impacts have proved a contentious area between the County and the environmental community, with former Supervisor Jacob at one point asking what it would take for environmental groups to stop suing the county (and winning). We therefore urge the County to perform an analysis and design avoidance or mitigation that meet CEQA requirements.

With regard to the proposed project, the concerns we identify are as follows. First, we are concerned about the possibilities for recreational fires on the project site sparking wildfires in the project site, Wright's Field, and homes and businesses downwind. Second, there has been talk that the proposed project would be an evacuation site, due to the number of parking spaces. Since South Grade Road is considered one of the most hazardous roads in Alpine, concentrating traffic in that area during an emergency seems like a recipe for trouble. Please *carefully* analyze evacuation both to and from the park site under all project alternatives. This is not about checking off boxes, it is about making sure people can evacuate safely during a disaster.

Project Alternatives

Please include a project alternative with a smaller, nature-focused, minimally developed park that has no impacts to the biological, cultural, and other resources of the project site, Wright's Field Ecological Preserve, and neighboring properties. Given voiced community concerns about the lack of maintenance on existing Alpine parks, please focus on making park upkeep and maintenance financially sustainable for the community and County. Also make its construction, maintenance, and rebuilding carbon neutral and environmentally sustainable, to meet federal, state, and county goals. Please also analyze each and every project alternative equally, as unequal analysis has been contentious on past county projects.

Thank you for taking this input. Please keep us informed of all developments with this project and associated documents and meetings, at conservation@cnpssd.org.

Sincerely,

Frank Landis, PhD
Conservation Chair
California Native Plant Society, San Diego Chapter

Van K. Collinsworth
Geographer / Director, Preserve Wild Santee

Pamela Heatherington, Director
Environmental Center of San Diego

[1] This from personal experience.

California Fish and Wildlife
JOURNAL

SPECIAL ISSUE

Effects of Non-consumptive Recreation on Wildlife in California

Journal for the Conservation and Management of California's Species and Ecosystems

California Fish and Wildlife

RECREATION SPECIAL ISSUE 2020

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California Fish and Wildlife, Recreation Special Issue; 6-10; 2020

Introduction

CAN OUR OUTDOOR ENTHUSIASM AND NATURE COEXIST?

RON UNGER, *Environmental Program Manager, Landscape Conservation Planning Program, Habitat Conservation Planning Branch, California Department of Fish and Wildlife*

[Note: As this special edition journal is published, our State, the nation, and the whole world are gripped by the corona virus pandemic. To slow its spread and not overwhelm limited healthcare resources, voluntary and mandatory directives for staying home, social distancing, and closing parks, reserves, and other public facilities have been put in place on a scale not seen for a hundred years, the time of the 1918 influenza (flu) epidemic.

Stories are emerging of more secretive wildlife seen in some park and urban areas normally filled with people, like the reports of bobcats roaming around empty Yosemite facilities, or an adult black bear roaming the nearly empty downtown Solvang. Hopefully, the pandemic and its horrible devastation will be over very soon, and we may again visit and appreciate our parks and wilderness areas. Hopefully, too, we may gain more information on wildlife's response to fewer visitors that helps us improve our management of parks and reserves in a way that protects wildlife and their habitat while also providing for great recreation experiences.]

"Everybody needs beauty as well as bread, places to play in and pray in, where nature may heal and give strength to body and soul alike" (The Yosemite, 1912). John Muir wrote so eloquently of the importance of taking time to be in, and play in, Nature to heal and nourish our spirit and help us to balance the challenges of our everyday lives. Now more than ever, people find a need to balance their work and domestic lives with the wonders, serenity, and invigorating challenges inherent in playing in Nature. In a world increasingly dominated by computers, cyberspace, and cities, people find a need to go and enjoy the Great Outdoors.

But what is the capacity of Nature to absorb the onslaught of millions of us hiking, riding, flying, boating, and otherwise tromping around the forests, fields, mountains, valleys, streams, and rivers on the other 40,000 or more species that also live in and depend on California? An increasing body of evidence is emerging that indicates non-consumptive recreational activities like hiking and biking, which don't involve harvesting of resources, can have harmful effects on species, their habitat, and efforts to protect them. As our population continues to grow and new and popular recreation technologies develop, California's natural areas are experiencing increased and changing recreation demands, such as increased numbers of hikers, nighttime group trail biking with lights, and electronic mountain bikes in wilderness areas.

Many federal, state, and local agencies' missions include non-consumptive, outdoor recreation, since it is often believed to be consistent with wildlife conservation. It is also widely believed that those who know and observe Nature are more likely to appreciate and protect her resources. Recently, however, several sites acquired primarily for conservation

have experienced extreme recreation pressures such as the Disney-like crowds coming out to see "superblooms" of native flowers of the desert in the spring or mountain biking occurring in areas where it is illegal along with the creation of several miles of unauthorized trails. So, how can we continue to provide for and manage appropriate, legal recreation opportunities while also protecting California's amazing and vast diversity of plants, fish, and other wildlife species and their habitats? How and where can we acquire separate lands for recreation access and for protecting habitat instead of frequently demanding too much recreation access on lands set aside for conservation of species and habitat? And, how can we facilitate various consumptive and non-consumptive recreation groups (e.g., hikers, mountain bikers, equestrians, off-highway vehicle users, hunters, anglers) and conservation groups (e.g., environmental activists, land trusts, resource agencies) to work together to advocate for acquiring and managing separate recreation and conservation lands instead of increasingly coming into conflict with one another over the use of the same lands for both purposes?

This special edition journal seeks to tackle this and related questions. In the introductory essay, "Non-consumptive Recreation & Wildlife Conservation: Coexistence through Collaboration," Dr. Ashley D'Antonio points out the unique need and opportunity California has for addressing recreation use as a social-ecological system (SES) based on its high biodiversity and quickly increasing recreation use of protected lands. Mitrovich, Larson, Barrows, Beck, and Unger, in "Balancing Conservation and Recreation," point to a need for recreation and conservation stakeholders to work together to ensure that sufficient areas are acquired for both uses and to help plan and manage conservation lands better to reduce adverse effects on wildlife and natural resources. They summarize some of the varied research going on in the field, on wildlife behavior and physiology, habitat degradation and fragmentation, reproduction and survival, community composition and richness, and other topics. Indirect effects like the shifts in day and night activity patterns between predators and prey lead to questions on what effects that has on wildlife interactions and possible changes that may lead to in a whole ecosystem. Two case studies cover visitor perceptions and values, and the importance of having groups with different values come together and work through their differences to build trust and facilitate better management decisions and stakeholder support.

The research paper, "Increased hiking and mountain biking are associated with declines in urban mammal activity," by Larson, Reed, and Crooks provides findings on how some wildlife can respond rapidly to changes in the levels of human disturbance, which may help planners design targeted trail closures to reduce recreation impacts in important areas. Townsend, Hammerich, and Halbur conducted somewhat similar research to that of Larson, Reed, and Crooks and present their findings in "Wildlife occupancy and trail use before and after a park opens to the public." Their research provides good insights into how differently various wildlife species respond to trail use by people, including strong differences in how soon and how much species may habituate to people's presence. Baas, Dupler, Smith, and Carnes make the case in "An assessment of non-consumptive recreation effects on wildlife: current and future research, management implications, and next steps" for doing more research to help wildlife and park managers more effectively manage and respond to non-consumptive recreation impacts on wildlife species and their habitats.

Elizabeth Lucas points out deficiencies and a need to improve how recreation is sited, monitored, managed, and enforced in protected areas in her paper, "Recreation-related disturbance to wildlife in California – better planning for and management of recreation are vital to conserve wildlife in protected areas where recreation occurs." She also provides a review

of several research papers in her paper, "A review of trail-related fragmentation, unauthorized trails, and other aspects of recreation ecology in protected areas." Elizabeth points out the need for sufficient funding, science-based approaches to managing protected areas, and educating the public on recreation effects on wildlife, to achieve real protection of species and to retain the benefits of the protected lands. Elizabeth suggests several funding options including a compelling argument for establishing a recreation equipment excise fee or tax like those paid for over 80 years now by hunters and anglers to benefit habitat conservation. With so much use of outdoor areas now by "non-consumptive" recreation uses, and with declining popularity of hunting activities in the population at large, is it time to institute such a change for recreational users to pay their share of conserving and managing habitat?

Together, the articles in this special journal edition cover a broad array of research on recreation effects on wildlife. They provide interesting perspectives and offer a variety of solutions. Learning how to best manage non-consumptive recreation to provide great outdoor experiences while minimizing harmful effects on wildlife will continue to evolve as we learn more from research and experience. We hope that you find this special edition journal useful in your own exploration of this important and emerging field.

"Keep close to Nature's heart… and break clear away, once in a while, and climb a mountain or spend a week in the woods. Wash your spirit clean." –*John Muir*

Introduction--continued

NON-CONSUMPTIVE RECREATION AND WILDLIFE CONSERVATION: COEXISTENCE THROUGH COLLABORATION

ASHLEY D'ANTONIO, PHD, *Assistant Professor in Nature-Based Recreation Management, Gene D. Knudson Forestry Chair, Department of Forest Ecosystems and Society, Oregon State University*

The most basic principle in the field of recreation ecology—an interdisciplinary field that studies the ecological impacts of recreational activities and the management of these impacts—is that if outdoor recreation is allowed in an area, impacts to that ecosystem are inevitable. It is also established that outdoor recreation has a myriad of benefits to society that range from economic growth, improved human health and well-being, community building, and increases in an individual's connection to nature. Moreover, outdoor recreation is one of the primary mechanisms by which humans interact with the natural world in contemporary society. As a result, many county, state, and federal park and protected area (PPA) managers around the United States (U.S.) are faced with mandates or missions that require conserving natural resources while also providing quality outdoor recreation experiences. Key challenges facing researchers, conservation practitioners, and PPA managers as they try to balance conservation goals with recreation access are: understanding the mechanism and the level and extent of these impacts; identifying what level of negative impact, if any, is acceptable; and deciding how to mitigate or manage these impacts.

Within recreation ecology, the impacts from recreation to ecosystem components such as soil and vegetation are relatively well studied. The negative impacts of recreation to environmental factors such as water, air quality, soundscapes, and wildlife are less well understood. Studying the relationships between non-consumptive recreation use and impacts to wildlife can be complex. Part of this complexity is because impacts to wildlife can be direct (e.g., harassment or feeding) and/or indirect (i.e., habitat modification) and at times can be hard to measure or observe (e.g., changes in stress hormone levels in response to recreation presence) as compared to soil or vegetation impacts. Additionally, impacts from non-consumptive recreation use can be interacting with, or compounded by, other ecosystem pressures. These added pressures include, but are not limited to, habitat loss due to development or changes in land use, pressures from consumptive recreation (hunting or fishing), and/or climate change. Moreover, impacts at the wildlife population or community level often require long-term studies, which are somewhat rare in recreation ecology but admittedly more common in the wildlife sciences.

Despite these challenges, there is a recent resurgence of interest in studying the impacts of non-consumptive recreation use on wildlife species. Meanwhile, there is a recognition that studies focusing only on the social or human aspects of a PPA system are insufficient to address current recreation and conservation issues, especially those related to wildlife. Many recreation ecologists, conservation scientists, and managers have begun to view outdoor recreation in PPAs as a complex social-ecological system (SES). As such, we must enhance our understanding of the interactions and intersections between both the ecological and social systems that make up our PPAs. Addressing wildlife conservation and recreation

access in PPAs requires SES-focused thinking and collaborative problem solving.

The rich social and ecological systems comprising California make this state an excellent place to begin to address recreation use through an SES framework. California is one of the most biodiverse states in the U.S. and while 47% of the state is currently protected, 97% of these protected lands are opened to human access. Non-consumptive recreation use in PPA has increased rapidly in recent years across the U.S. but especially in Western states. California State Parks saw a 10% increase in total visitation numbers from the 2015/16 to 2016/17 fiscal year and many California national parks have seen exponential growth in visitation in recent years. As the U.S population becomes increasingly suburban and urban, PPAs that provide refugia and critical habitat for wildlife face increasing pressure from land use change and suburban expansion. Within California, this trend is evident as the state's population continues to grow while land use change, extreme droughts, and development increases pressure on California's PPAs.

Currently, PPAs and open space are limited, and wildlife species and their habitat face many ecological pressures. We are on the cusp of a resurgence and upswell of research exploring non-consumptive recreation impacts on wildlife. However, to meet conservation objectives, additional research is still needed to best inform recreation management in PPAs. Conserving and protecting wildlife species while providing quality recreation experiences to society requires interdisciplinary and transdisciplinary teams of researchers, managers, practitioners, stakeholders, and the public working together towards shared goals and objectives. Because of the social and ecological complexities and uncertainties around recreation impacts to wildlife, no individual field of science or management entity will be able to address this issue on its own. As such, this special issue is timely and important as it adds to the body of literature aimed at understanding non-consumptive recreation impacts to wildlife. Additionally, this special issue serves as a starting point for cooperatively exploring the challenge of protecting wildlife while balancing non-consumptive recreation use. If we are to meet conservation goals related to wildlife and wildlife habitat, it may not be appropriate to allow recreation use in all PPAs and at all times. However, collaborative dialogues (informed by the SES framework) around wildlife conservation are essential to guide decisions related to where, when, and how non-consumptive recreation use should be permitted in our PPAs.

California Fish and Wildlife, Recreation Special Issue; 11-28; 2020

Balancing conservation and recreation

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As California's population has grown to nearly 40 million people, and as the State's beautiful natural diversity draws tourists and explorers from around the world, outdoor recreation has also grown (California Department of Parks and Recreation 2013, 2017; Monz et al. 2019). New equipment and technology enable new activities, such as night-time mountain biking, while social media brings increasing numbers of people to areas seldom visited by people only ten or twenty years ago. With increased time and more sedentary work environments, our society is understandably demanding greater access to more land for outdoor recreation. However, since several species-protection challenges already exist throughout the State due to development, fragmentation, invasive species, altered fire regimes, and climate change, consideration of opening up additional wildlands for recreation presents new challenges to conservation.

Outdoor engagement with natural areas is recognized as a necessary part of people's well-being, yet recreationists are generally attracted to the same high-value open spaces and natural areas that harbor diverse plant and animal communities (Mancini et al. 2018). Accordingly, trails, access points, and associated infrastructure need to be planned and

managed appropriately to complement, rather than diminish, conservation values of lands dedicated to the protection of species and their habitats. In the absence of good planning, recreation-conservation conflicts are increasing, polarizing these two stakeholder groups and eroding their natural affinity and alliance. When conservation and recreation interest groups work together and conservation and recreation lands are planned and managed based on scientific research, a new opportunity emerges for a coordinated approach to protecting California's wildlife while also meeting the demand for high-quality recreational opportunities for diverse user groups.

Recreation and conservation interests would benefit from regular dialogue and collaboration with each other and with federal, state, and local land use authorities regarding regional and local land use planning, acquisitions, and management. A shared, basic understanding of applicable conservation objectives and regulations would provide context and perspective for recreational users and serve to help the two groups work together to ensure each of their interests are served rather than their respective needs being compromised. Without a close alliance among recreation and conservation interests, California risks having insufficient land areas set aside for the thousands of species that depend on California's natural areas, inadequate areas for recreation, and increasing conflicts between conservation and recreation needs. The necessary conversations, research, and determination to collaborate should be embraced and acted upon as soon as possible to help address these needs, reduce the potential for polarization among these stakeholders, and help ensure good land use planning and management decisions are made as development proceeds.

In this essay, we provide an overview of the mechanisms available to implement conservation in California and introduce many of the issues attributed to outdoor recreation when managing for wildlife and natural resources on conservation lands and other public open spaces. We then describe two case studies from our work in southern California that highlight the perceptions and values of outdoor recreationists when visiting conserved lands. The case studies also demonstrate what a successful balance between conservation and recreation uses can look like when moving from conflict to collaboration. We end with a discussion of what is required to achieve that balance and ways to minimize the impacts of outdoor recreation on wildlife and other natural resources.

CONSERVATION CONTEXT

As California's population grew from a few hundred thousand to nearly 40 million people in less than two hundred years, numerous species' populations have declined. Some, like the iconic grizzly bear (*Ursus arctos horribilis*), are now extinct in the state. Over 450 plant and animal species in California are now listed by the federal or state government as threatened or endangered (CDFW 2019). The cost of species recovery can be enormous, such as the tens of millions of dollars spent to save the majestic California condor (*Gymnogyps californianus*; Walters et al. 2010). To prevent further species declines, a number of laws and regulations exist to avoid, minimize, or compensate for impacts of human activities on species. In California, these include the federal Endangered Species Act (ESA), the California Endangered Species Act (CESA), the National Environmental Policy Act (NEPA), the California Environmental Quality Act (CEQA), among others. Approximately half of California is federally or state-owned lands with a variety of uses, from national forests and state parks to multi-use areas and reserves. In addition to these areas, an appreciable

amount of land is conserved in California as mitigation under ESA, CESA, CEQA, and other laws and regulations.

Successful conservation leads to the protection of species and habitat and the preservation of natural landscapes. Principal types of conservation lands in California include reserves acquired and managed as part of Habitat Conservation Plans (HCPs) and Natural Community Conservation Plans (NCCPs), national parks and monuments, state ecological reserves and wildlife areas, state parks, lands owned by private entities (e.g., land trusts), lands with conservation easements, and mitigation lands. The relative importance of conservation and recreation values to the management goals of these lands vary. For example, state and national parks generally emphasize recreational uses more than mitigation lands and ecological reserves. Sixteen HCP/NCCPs have been approved in California covering part or all of seven counties. Through the new Regional Conservation Investment Strategy (RCIS) Program established in 2017, one RCIS has been approved and an additional eight Regional Conservation Investment Strategies (RCISs) are currently in development or have been submitted for review and approval by the Department of Fish and Wildlife (for more information about RCIS and NCCP programs, see Appendix I). The nine RCISs together will cover part or all of 11 counties. There are also over 130 conservation and mitigation banks in the state, privately held conservation lands, and hundreds of mitigation sites. In total, tens of thousands of acres of habitat have been conserved in California through proactive investments and mitigation. Over one and one-half million acres will be conserved in California under approved HCP/NCCPs, benefiting hundreds of species listed as endangered or threatened under federal and state species protection laws.

OUTDOOR RECREATION

Millions of Californians and visitors recreate outdoors on natural lands within the state each year (Outdoor Industry Association 2019). Examples of outdoor recreation activities include hiking, trail running, mountain biking, horseback riding, backpacking, camping, and motorized activities. The positive effects of outdoor recreation are numerous. Stewardship values are enhanced. Appreciation of nature is magnified as people are exposed to the inherent beauty, complexity, and serenity of natural systems. The next generation of land stewards and conservationists are born out of the experience of being introduced to wildlands when young. Equally important, the mental health benefits of exposure to the outdoors and participation in nature are now well-recognized (Louv 2005; Thomsen et al. 2018). For a society that is increasingly becoming more urban and digital, the restorative properties of nature and the increased social well-being of individuals and communities is ever more important.

Despite these benefits, the negative effects of recreation on wildlife can be profoundly damaging to species and their habitats and must be considered when planning for conservation areas (Hammitt et al. 2015). Trails lead to habitat degradation and fragmentation, which increase when visitors go off-trail and informal trails proliferate. Harassment of wildlife, though often unintended, occurs with increased visitation to an area. Less obvious impacts to wildlife, not easily measured, have been tied to noise, light pollution, trash, and other factors associated with recreation activities.

In general, it can be difficult to accept that recreation activities, especially quiet, non-motorized activities like hiking and mountain biking, can have harmful effects on wildlife. Many types of recreation cause little physical habitat change. Perhaps as a result, recreation

was widely assumed to be a "benign use" that is compatible with conservation goals (Knight and Gutzwiller 1995) and is permitted in the vast majority of protected areas worldwide (Eagles et al. 2002; IUCN and UNEP 2014). Many HCP/NCCPs include a general provision that allows for "low-impact nature trails" without strongly defining what that means and what types and levels of use would be acceptable, given the species that are to be protected. The viewpoint that recreation is a benign use may be changing, however. In recent years, researchers have found evidence that a variety of recreation activities and intensities can have detrimental impacts on wildlife (Geffory et al. 2015; Larson et al. 2016; Samia et al. 2017).

RECREATION EFFECTS ON WILDLIFE

Behavior, activity budgets, and physiology

Behavioral reactions, such as flight, flushing, or vigilance are some of the most commonly-observed and studied wildlife responses to recreationists (Larson et al. 2016). Changes in activity budgets have also been observed, with animals typically spending less time in activities such as foraging and caring for young and more time moving or being vigilant when recreationists are present (Schummer and Eddleman 2003; Arlettaz et al. 2015). Physiological responses, such as increases in stress hormones (Arlettaz et al. 2007) or decreased body mass (McGrann et al. 2006), are less obvious to observe, and can occur even when a corresponding behavioral response does not. It is critical not to assume that an animal is tolerant of recreation simply because it does not exhibit a visible response.

Habitat degradation and fragmentation

Recreation can degrade or fragment habitat, resulting in habitat that is otherwise of high quality being used less frequently or not at all. This is particularly concerning in highly fragmented or developed landscapes where remaining habitat is scarce and there is limited opportunity for wildlife to move to alternative areas. Researchers have observed avoidance of areas used by recreationists in species as diverse as grizzly bears (Coleman et al. 2013), wolverines (*Gulo gulo*; Heinemeyer et al. 2019), caribou (*Rangifer tarandus*; Lesmerises et al. 2018), capercaillie (*Tetrao urogallus*; Coppes et al. 2017), and dolphins (*Tursiops* spp.; Lusseau 2005).

Reproduction, survival, and abundance

Assessing recreation's impacts on wildlife population abundance or vital rates can be difficult and time-consuming, and is therefore largely unknown. In one of the few studies of population trends in relation to recreation, Garber and Burger's long-term study (1995) observed dramatic declines in North American wood turtle populations after the area was opened to recreation. Reproductive success is one of the better-studied population vital rates; negative effects of recreation on reproductive success have been observed in several species including elk (*Cervus canadensis*; Shively et al. 2005), penguins (Giese 1996; Lynch et al. 2010), and plovers (*Charadrius* spp.; Lafferty et al. 2006; Yasué and Dearden 2006). However, other studies have found that habituation can moderate impacts of recreation on reproductive success (Baudains and Lloyd 2007).

Community composition and richness

Within an ecological community, species respond to recreation differently. This can lead to changes in community composition if more sensitive species avoid areas with recreation or decline in abundance while the habitat use or abundance of tolerant species remains constant or even increases due to reduced competition. When the sensitive species are native and the more tolerant species are non-native, this can lead to dramatic declines of native species as compared to their non-native counterparts (Reed and Merenlender 2008). Overall species richness can also decline if sensitive species disappear from local communities (Bötsch et al. 2018).

Indirect effects

Recreation can also cause other changes that indirectly affect wildlife, many of which are not well understood. Shifts in diel activity patterns could change the way that species interact with each other or with their environment, potentially leading to increased interspecific competition during nighttime hours or increased overlap between predators and their prey (Gaynor et al. 2018). Recreation can facilitate the spread of non-native species in freshwater, marine, and terrestrial environments (Anderson et al. 2015), which can have dramatic effects on native wildlife. Recreation activities also often involve infrastructure (e.g., parking lots, maintenance buildings, roads, ski lifts), which can lead to further habitat loss and fragmentation (Nellemann et al. 2010).

Examples of recreation impacts from southern California

Examples from southern California, where much of our work occurs, highlight some of the many ways recreation can impact natural resources. Results of ten years of camera-trap studies on conservation lands in Orange County indicate mule deer (*Odocoileus hemionus*) and coyotes (*Canis latrans*) are shifting the timing of activity due to the presence of humans on trails creating novel predator-prey conflicts for wildlife (Patten et al. 2017). Observed shifts toward more nocturnal activity by both species leads to greater temporal overlap in activity periods between mule deer and their principal predator, the mountain lion (*Puma concolor;* Figure 1). Greater overlap between coyotes and gray foxes (*Urocyon cinereoargenteus*) has also been observed, leading to predicted changes in predator-prey dynamics.

Bobcat (*Lynx rufus*) movement modeling using more than ten years of telemetry data in the 7,284-ha South Coast Wilderness of coastal Orange County highlights the importance of maintaining regional connectivity among isolated parcels and continued exclusion of human presence at culverts and other critical linkage points along the coast (Boydston and Tracey 2018). Within landscapes containing natural areas constrained by development, protected habitat and other high-value open space is a premium for wildlife. Providing for safe, unobstructed passage for wildlife among isolated parcels, especially at culverts and other pinch-points, is essential to enable access to high-value habitat within these otherwise constrained landscapes.

In heavily used open space areas, some wildlife appear to develop a tolerance for regular human activity on trails over time. However, patterns of wildlife habitat use can be disrupted by disturbances occurring outside this regular activity, such as large recreation

events, off-trail visitor behavior, or the proliferation of new social trails, even in areas that traditionally see high levels of visitor use. At a local scale, observations of breeding bird behavior before, during, and after a mountain bike race at a wilderness park in Orange County highlights elements of both sides of this phenomenon (Hamilton et al. 2015). In this example, breeding bird behavior continued uninterrupted in areas experiencing similar amounts of activity along the racecourse during the event as to what was experienced prior. As people gathered in numbers on and off the trail at the designated start/end staging area for the event, evidence suggests behavior was disrupted as the sheer volume and continual

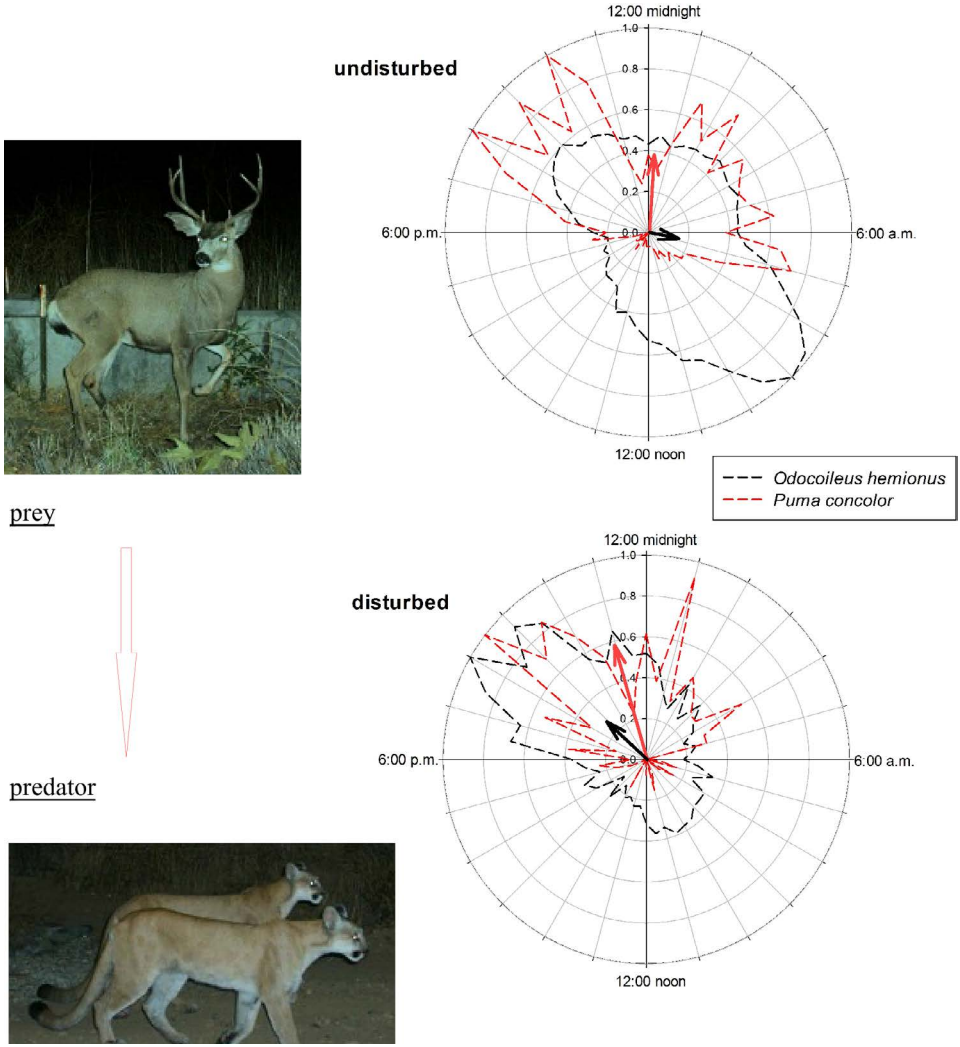

Figure 1. Diel activity of the mule deer and mountain lion with or without human disturbance. Arrows indicate time (direction) and proportional magnitude (length) of mean activity, and the "net" displays the spread of activity on a 24-h clock, binned at 30-minute intervals. Note the prey's (the deer) nocturnal shift when disturbance was present. (Figure credit: Patten et al. 2019)

presence of people gathered around the staging area was atypical for this location within the park.

CASE STUDY:

UNDERSTANDING VISITOR PERCEPTIONS AND VALUES IN ORANGE COUNTY

To successfully strike a balance, we need to know more about the human perspective of conservation. By surveying visitors to protected natural areas in southern California over the last couple of years, we learned there is potential for a shared vision of nature protection addressing the needs of both conservationists and outdoor recreationists. Clearly the issues are complex, but with good planning and communication, much can be done to support the creation of a collective vision for compatible conservation and recreation.

Natural Communities Coalition (NCC) is the non-profit management corporation overseeing implementation of the conservation strategy for the County of Orange Central and Coastal Subregion NCCP/HCP. Stretching from the Newport Coast to the Santa Ana Mountains, over 20,200 ha (50,000 acres) of conserved lands together with National Forest are embedded within the conservation plan's 84,000-ha (208,000-acre) planning area. The 75-year plan, signed in 1996, was the first landscape-scale NCCP in the state and one of the first multi-species HCPs nationally.

With 3.2 million residents in Orange County (Center for Demographic Research 2019), the demand for outdoor recreation on lands protected for conservation purposes is ever-present and increasing. Equally important is the recognized need and desire by the community to conserve the rich natural heritage of the southern California region. In Orange County, like in other high-value natural areas of the state experiencing rapid population growth, there is a strong need to strike a balance between conservation and recreation.

Recreation management is one of four main tenets of the regional landscape-level conservation strategy managed by NCC. Recognizing the increasing need to address this topic, NCC staff began focused and meaningful conversations with recreation ecologists and then followed with talking directly to park visitors to understand the human dimensions, that is, the motivations, desires, and values of visitors to the conserved lands. Partnering with Dr. Christopher Monz, Professor of Recreation Resources Management in the Department of Environment and Society at Utah State University, the organization surveyed close to 2,000 visitors in the spring and fall seasons of 2017 and in the spring of 2018 to better understand their perceptions, values, and characteristics (Sisneros-Kidd et al. 2019). In this process, the research team used a theoretical framework that allowed for the identification of internal constructs embedded within visitor questionnaires to reveal motivations and define different user groups. Through the work, two principal groups or clusters of visitors were discovered, those who are motivated most by the opportunity to experience nature immersion and those who are more focused on fitness-based recreation.

Surprisingly, given the urban-proximate setting, and in contrast to the expectations of local land managers, by almost two to one, recreationists were looking to experience nature immersion compared to those seeking fitness-based recreation. These visitors were more motivated by solitude and escape, learning about and experiencing nature, spiritual renewal, and the social experience, versus those in the fitness-based recreation group who

were motivated principally by challenge and outdoor exercise. Learning that the motivation and values of most visitors are more in alignment with resource protection than expected, we had to shift our thinking. Rather than focusing on direct conflict between recreation and conservation, we had to reevaluate how the conversation about balancing recreation and conservation is framed. Knowing it is often the most vocal and well-organized user groups who receive the greatest attention, whether from rangers at a local park or elected officials at a public meeting, we recognized it was of value for decision-makers to be informed of the findings and equally consider the motivations, values, and desires of the quiet majority in these public spaces and forums.

Digging deeper into the results of the work, we found people largely recognize the value of habitat and natural resource conservation; however, they too want to be part of the story. People do not want to be left "standing on the sidelines or looking over the fence;" they want to experience the rich natural resources that make California so unique. When asked how satisfied they were in their ability to achieve a variety of experiences during their visit to a park, visitors reported they were often left wanting more when it came to learning about nature and becoming more in touch with their spiritual values.

Visitor responses indicated they experience place attachment. When asked, they recognize the lands upon which they choose to regularly recreate are not necessarily unique relative to other protected areas. However, to them these lands and parks are special, meaningful, and important. Place attachment may be reflected in the high repeat visitation rates of visitors. More than half of those surveyed visited parks more than 50 times within the same year. Furthermore, many of the visitors live within neighboring communities. For almost half of the parks included in the study, more than 25% of visitors live within 3 miles of an entrance location (Mitrovich, unpublished data). To these people, the parks are a recognized and utilized part of their local community's resources.

Recreation is multidimensional and multifaceted, and we recognize a more sophisticated approach to finding solutions is warranted when seeking to minimize recreational impacts on sensitive natural resources. Impacts and motivations vary by user group, as does the attractiveness of different topography. From the surveys, we learned mountain bikers look to avoid crowds, are most knowledgeable about "leave no trace," most interested in more trails, and most likely of all user groups to be satisfied in their ability to get away from the demands of life when out on trails. Dog walkers, on the other hand, were least knowledgeable about "leave no trace," most avoided by other recreational groups, and least satisfied in their park experiences as it relates to their ability to learn more about plants and animals. Some hikers and runners were concerned about the number of mountain bikers they encountered in particular parks and along certain trails. Different topographic features attracted different users. Steep trails that offer high speeds and technical challenges are attractive to mountain bikers but can be off-putting to other user groups. In unregulated spaces popular with the masses and advertised through social media, trails can be degraded and spider, further fragmenting and degrading available habitat. The overlap between areas used for recreation and high-value wildlife habitat may be greatest with nature-based recreationists.

One positive take-home, as we look for solutions, is that visitors in urban landscapes are much more tolerant of crowded conditions than previously recognized by land managers. Parks in Orange County have seen a dramatic increase in use over the last decade, with increases of greater than 50% not uncommon over a 4-year period (Monz et al. 2019). However, at many parks considered to be "crowded" by land managers, over 80% of re-

spondents surveyed did not feel the presence of other people on the trail interfered with their activities or made them feel rushed or slowed them down during their visit. Equally, over 80% of respondents in 2018 did not feel the number of people at the park increased their risk of injury.

Although many folks are comfortable in a more crowded space, not everyone is comfortable with the changing dynamics and increases in observed use experienced over the last decade. Across both before-mentioned measures, there were respondents that felt the number of people at the park during their visit did increase their risk of injury at least some of the time, and other visitors and their activities interfered with their visit. Like wildlife, it appears people's tolerance of novel conditions is not fully universal and may differ across generations, by past experiences, and expectations (Shelby et al. 1983). When coupled with their understanding that off-trail activity is most impactful, the general tolerance of folks to increased visitation rates gives hope as we look for solutions to meeting increased demand while paying the necessary attention to detail to create the recreational opportunities valued by most that continue to honor the shared commitment and need for lasting conservation.

CASE STUDY:

CONFLICT TO COLLABORATION IN THE COACHELLA VALLEY

Now we turn to one example of how a region is addressing the question, what to do when trail users and sensitive species like the same habitat? Like other areas of southern California, the Coachella Valley in the desert and mountain regions of eastern Riverside County has seen a remarkable increase in the demand for outdoor recreation on trails, especially hiking and mountain biking. In this desert resort area, land of more than 100 lush golf courses, demand for golf is flat, while hiking has surged in popularity, in large part due to the influence of social media.

In 2008, the California Department of Fish and Wildlife (CDFW) and the U.S. Fish and Wildlife Service (USFWS) approved the Coachella Valley Multiple Species Habitat Conservation Plan/Natural Community Conservation Plan (CVNCCP) with a 75-year permit. Like other efforts in California and beyond, it was a visionary effort to balance conservation and development. The plan encompasses an area of almost 500,000 ha (1.1 million acres) from Palm Springs to the Salton Sea and beyond. Implementation of the plan is overseen by the Coachella Valley Conservation Commission (CVCC), made up of elected officials from participating cities, Riverside County, local water districts, and other agencies.

However, several years earlier, the conflict between trail users and agency biologists nearly derailed the CVNCCP. During development of the plan, proposals by state and federal wildlife agencies to impose seasonal closures on some trails galvanized trail users to organize and turn out in large numbers at public hearings. The proposal to close trails centered on concerns about the impacts of trail use on Peninsular bighorn sheep (*Ovis canadensis nelsoni*), a state and federally listed endangered species (Figure 2). In response, trail users read scientific literature, interviewed bighorn sheep biologists, and questioned the scientific basis of the trail restrictions. They used their newfound knowledge and spoke passionately about their concerns to elected officials, often quoting published scientists.

When the CVNCCP was approved in 2008, it did not include the trail closures that had been envisioned. Public input from trail users convinced decision-makers to avoid these measures. It also convinced conservation planners that a full trails management plan needed

to be developed for the CVNCCP. Unfortunately, the process also left trail users alienated and with a lack of trust in the state and federal wildlife agencies. Wildlife agencies were suspicious of trail users' motivations. It would be years before these attitudes changed. Trail users seeking nature immersion, who could have been a natural constituency for support of the conservation proposed by the CVNCCP, continued to question the scientific basis of the trails plan. Even after the CVNCCP was completed and fully permitted, the lack of trust remained.

To provide a forum for input from trail users and local governments, the final CVNCCP called for formation of a Trails Management Subcommittee, composed of a representative from each of nine cities involved in the CVNCCP, the Agua Caliente Band of Cahuilla In-

Figure 2. In some areas of the Santa Rosa and San Jacinto Mountains National Monument, seasonal trail closures are in place to allow bighorn sheep and other wildlife access to waterholes during the hot summer months. (Photo credit: CDFW)

dians, trail user groups (mountain bikers, hikers, equestrians), environmentalists, biologists from CDFW, USFWS, Bureau of Land Management, and other land management agencies. The group was charged with providing recommendations on trails management, annually reviewing the status of bighorn sheep, and communicating trails-related information to stakeholders. Their tasks required them to develop a shared understanding of relevant conservation objectives and regulations while they worked together to accomplish their charge.

A dedicated group of volunteers, the subcommittee took their responsibility seriously and worked hard. Meetings were well attended and often animated. Passions flared, and sometimes sparks flew. On occasion, meetings devolved and became acrimonious and full of

conflict. Trail users continued to question the scientific basis for trails management actions proposed by "the agencies." Agency biologists doubted the trail users' commitment to the protection of bighorn sheep and were reluctant to share data. Unfortunately, throughout the process, scientifically rigorous data on the effects of trail use on bighorn sheep was limited. The studies needed to understand the relationship between trail use and bighorn sheep had not been done. The CVNCCP was approved in 2008, the year the recession hit and resources for local, state, and federal agencies were further limited by lack of funding.

In 2011, the conflict between recreation and habitat ended up in the state legislature when CDFW closed the upper portion of the very popular Bump and Grind Trail to protect bighorn sheep. Though not a trail which offers the experience of solitude, the Bump and Grind provides a great cardio workout, with hikers numbering more than 1,000 some days. Questioning whether any studies to prove that hikers have an impact on the endangered bighorn had been presented, trail users went to their state legislators. Ultimately, a compromise was worked out and Governor Brown signed legislation in October 2013. The upper Bump and Grind is now closed for three months during the sensitive bighorn sheep lambing season, from February through April, and open for the remaining nine months of each year. The Coachella Valley Conservation Commission worked with CDFW to install a fence to discourage off-trail travel and educational signs about bighorn sheep.

Despite the challenges, the Trails Management Subcommittee persevered. They worked through the challenges, developed more trust, and learned to work together. They completed an update to the 2008 Trails Management Plan in 2014. The updated plan emphasizes the adaptive management approach described in the CVNCCP. It calls for research on the relationship between bighorn sheep habitat use and trail use, prior to construction of new trails. Technology has made such research more feasible, especially in the rugged and remote terrain of the Santa Rosa and San Jacinto Mountains National Monument. Since 2015, GPS collars have been placed on bighorn sheep, providing data on their movements and habitat use. The CVCC is now working on a study of bighorn sheep and trails, led by Dr. Kathleen Longshore of the U.S. Geological Survey and funded by a grant from CDFW. The trails subcommittee is actively involved with researchers in the development of the study protocol and review of all data. Field work began in fall 2019, with volunteers collecting data on recreational trail use and researchers comparing the human use data with bighorn sheep collar data.

Conflict has been replaced with collaboration. Although all of the best practices were not used initially, when they were used, they became lessons learned. If people understand why, they are more likely to go along with regulations (Marion and Reid 2007). Furthermore, when the need for regulation or constraints are understood, constraints can become a positive as they provide the basis for best practices and assure access via responsible use.

WHAT IS NEEDED TO ACHIEVE BALANCE? WHAT WORKS?

Several land management decisions are being made today with long-term implications for the state of biodiversity and human wellness within California. Without collaboration among recreation and conservation interests, California risks insufficient lands being set aside for the benefit of protecting species, insufficient lands for recreating, and poorly located lands for both purposes, with people and other species suffering the consequences. Recreation and conservation stakeholders need to talk and work with each other and with

ecologists and land planners early and often in the regional visioning and land planning process to ensure both interests get what is needed in a way that strikes a balance for species and habitat protection, and people's access to the outdoors.

To achieve a better land use future for conservation and recreation outcomes, we recommend early investment in working relationships. Increased early communication among all stakeholders, land planners, and managers, together with basing decisions on the best available science, can help reduce land use conflicts, the loss of species, and lower-quality recreation experiences. Groups should accept there will be situations when they collectively agree to disagree. However, the long-term commitment to work together will increase the likelihood of achieving goals and objectives for all interests. Most land conserved through public funding sources and/or mitigation and all HCP and NCCP properties have some form of Resource Management Plan (RMP) and/or Conservation Easement attached to them. It is critical RMP's are developed with a "clean slate" to identify critical sensitive species, regional context, and wildlife linkages up front. This, in turn, identifies potential areas appropriate for trails and other recreational uses, thus reducing debate and conflict later.

We also recommend establishing appropriate monitoring programs that are used to evaluate conservation and recreation outcomes and modify management plans to better achieve the original goals and adjust to changing conditions. The wide variety of nature-based recreational activities, timing and frequency of those activities, and numbers of people that participate in them, all result in a complex array of potential effects. Adding to that is the complexity of behavioral responses and sensitivities of different species to those activities. Recognizing this complexity and planning according to research findings that are available, and the anticipated growth or other changes expected, can help planners create conservation areas and recreation areas positioned to avoid future conflicts.

Opportunities to be inclusive and reach out to stakeholders as partners in the long-term management of protected lands are numerous. By simply involving everyone up-front, community members can be engaged early in the planning process and contribute to the search for solutions. Volunteers can help to enforce site rules using peer pressure. They may also be able to help with site maintenance, monitoring, and identification of possible management actions, such as when monitoring information indicates a problem exists. An open phone line to land managers is essential and over time naturally builds relationship and trust.

How can effects be minimized?

Using good science in the decision-making process is key, as is making data transparent and remembering the importance of educating the public throughout the process. Planning efforts should search for and incorporate relevant scientific findings. Despite the variability in species responses to different types and intensities of recreation, researchers have identified some ways to minimize the effects of recreation on wildlife:

- Monitor and prevent unauthorized trail creation and off-trail use. Many animal species respond more strongly to recreationists in unexpected places, such as off-trail (Stankowich 2008; Heinemeyer et al. 2019), so increasing the predictability of human presence by constraining people to the existing trail network may help mitigate negative effects.
- Limit nighttime access to parks and trails. Since people are primarily active during the daytime, many animal species avoid interactions with people by increasing the proportion of their activity that takes place at night (Gaynor et al. 2018). While the

implications of this shift for foraging success and interspecific interactions are largely unknown, limiting activity to daytime hours may be a way for humans and wildlife to coexist in parks and natural areas. Nighttime recreation is growing in popularity but may prevent animals from temporally avoiding people, and should be limited in general, and probably all together avoided in urban-proximate wildland areas where the existence of refugia is already severely limited spatially.

- Leave areas without trails, both within individual properties and at landscape scale. For the most part, research has not yet identified 'safe' levels of human activity that result in minimal negative outcomes for wildlife. Some species appear to respond to very low levels of human activity and would benefit from blocks of trail-free habitat; in one example, mountain lions, coyotes, and bobcats increased nighttime activity and decreased daytime activity in locations with levels of use as low as two people per day (Wang et al. 2015).
- Plan access points and infrastructure carefully. Parking lots and other facilities can increase the level of use at corresponding trails (Larson et al. 2018). On the other hand, a lack of parking space at popular trails can result in public safety issues if visitors park along busy roadways. Improper parking can also impact habitat, which can cascade to impact wildlife as well.
- Use seasonal trail closures during sensitive periods. For many species, the most sensitive period is the breeding period, when disturbance can lead to reduced reproductive success (Bötsch et al. 2017), which in turn can result in population declines.
- Collect visitor use data. Without some knowledge of the intensity and distribution of recreational use, it is difficult for managers to know where and when impacts on sensitive wildlife species may be occurring. Monitoring equipment can be costly to purchase and maintain, but basic measures like periodic manual counts at parking lots or trailheads can be helpful in tracking trends, and there are promising emerging approaches using information that visitors share on social media platforms, mobile devices, and fitness applications (Fisher et al. 2018; Monz et al. 2019; Norman et al. 2019).
- Consider diverse visitor perspectives and values. Employ contemporary scientific approaches so key components in the human dimension of recreation (e.g., perceptions, characteristics, and motivations) can be understood more formally and inform a planning process for long-term sustainable use.
- Determine thresholds of acceptability of key indicators of resource and social conditions. Recognize "carrying capacities" exist for protected lands and their identification is a key component in the planning process and essential to developing a range of possible management actions, from the spatial and temporal separation of different types of recreational uses to acceptance and identification of high and low intensity use areas within the greater protected open space network.

An opportunity is emerging to expand upon local successes and encourage a new dialogue among agencies, conservationists, and recreationists, both at the local level and regionally, in support of the expanded protection of natural lands throughout California. We encourage interested parties to continue to learn more about the use of conservation planning tools and visitor use management made available through the CDFW and USFWS, and Interagency Visitor Use Management Council (Appendix I). Forming partnerships allows stakeholder groups to work together to plan ahead of growth and build regional conservation

strategies for the increased protection of natural lands, addressing the long-term conservation needs of California's natural resources and the strong desire of people to experience nature.

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LITERATURE CITED

Anderson, L. G., S. Rocliffe, N. R. Haddaway, and A. M. Dunn. 2015. The role of tourism and recreation in the spread of non-native species: a systematic review and meta-analysis. PLoS ONE 10:e0140833.

Arlettaz, R., S. Nusslé, M. Baltic, P. Vogel, R. Palme, S. Jenni-Eiermann, P. Patthey, and M. Genoud. 2015. Disturbance of wildlife by outdoor winter recreation: allostatic stress response and altered activity–energy budgets. Ecological Applications 25:1197–1212.

Arlettaz, R., P. Patthey, M. Baltic, T. Leu, M. Schaub, R. Palme, and S. Jenni-Eiermann. 2007. Spreading free-riding snow sports represent a novel serious threat for wildlife. Proceedings of the Royal Society B 274:1219–1224.

Baudains, T. P., and P. Lloyd. 2007. Habituation and habitat changes can moderate the impacts of human disturbance on shorebird breeding performance. Animal Conservation 10:400–407.

Bötsch, Y., Z. Tablado, and L. Jenni. 2017. Experimental evidence of human recreational disturbance effects on bird-territory establishment. Proceedings of the Royal Society B 284:20170846.

Bötsch, Y., Z. Tablado, D. Scherl, M. Kéry, R. F. Graf, and L. Jenni. 2018. Effect of recreational trails on forest birds: human presence matters. Frontiers in Ecology and Evolution 6:1–10.

Boydston, E. E., and J. A. Tracey. 2018. Modeling resource selection of bobcats (*Lynx rufus*) and vertebrate species distributions in Orange County, southern California. U.S. Geological Survey Open-File Report 2018–1095, Reston, VA, USA.

California Department of Fish and Wildlife (CDFW). 2019. Threatened and Endangered Species Protected under the California Endangered Species Act. California Department of Fish and Wildlife, Sacramento, CA, USA. Available from wildlife.ca.gov/Conservation/CESA (Jan 2020).

California Department of Parks and Recreation. 2017. State Park System Statistical Report 2016/2017 Fiscal Year. Sacramento, CA, USA. Available from www.parks.ca.gov/pages/795/files/16-17%20Statistical%20Report%20FINAL%20for%20web.pdf (Jan 2020).

California Department of Parks and Recreation. 2013. State Park System Statistical Report 2012/2013 Fiscal Year. Sacramento, CA, USA. Available from https://www.parks.ca.gov/pages/795/files/12-13%20statistical%20report%20final%20inter-

net.pdf (Jan 2020).
Center for Demographic Research. 2019. California State University, Fullerton, USA. Available from: www.fullerton.edu/cdr/ocff.pdf (July 2019).
Coleman, T. H., C. C. Schwartz, K. A. Gunther, and S. Creel. 2013. Grizzly bear and human interaction in Yellowstone National Park: an evaluation of bear management areas. Journal of Wildlife Management 77:1311–1320.
Coppes, J., J. Ehrlacher, D. Thiel, R. Suchant, and V. Braunisch. 2017. Outdoor recreation causes effective habitat reduction in capercaillie *Tetrao urogallus*: a major threat for geographically restricted populations. Journal of Avian Biology 48:1583–1594.
Eagles, P. F. J., S. F. McCool, and C. D. Haynes. 2002. Sustainable tourism in protected areas: guidelines for planning and management. IUCN, Gland, Switzerland and Cambridge, UK.
Fisher, D. M., S. A. Wood, E. M. White, D. J. Blahna, S. Lange, A. Weinberg, M. Tomco, and E. Lia. 2018. Recreational use in dispersed public lands measured using social media data and on-site counts. Journal of Environmental Management 222:465–474.
Garber, S. D., and J. Burger. 1995. A 20-year study documenting the relationship between turtle decline and human recreation. Ecological Applications 5:1151–1162.
Gaynor, K. M., C. E. Hojnowski, N. H. Carter, and J. S. Brashares. 2018. The influence of human disturbance on wildlife nocturnality. Science 360:1232–1235.
Geffory, B., D. S. M. Samia, E. Bessa, and D. T. Blumstein. 2015. How nature-based tourism might increase prey vulnerability to predators. Trends in Ecology & Evolution 30:755–765.
Giese, M. 1996. Effects of human activity on adelie penguin *Pygoscelis adeliae* breeding success. Biological Conservation 75:157–164.
Hamilton, R., D. Kamada, and B. Leatherman. 2015. Biological observations and recommendations – Whiting Ranch Ultimate Time Trial, Whiting Ranch Wilderness Park, Orange County, CA. Report by Hamilton Biological to Natural Communities Coalition, Irvine, CA, USA.
Hammitt, W. E., D. N. Cole, and C. A. Monz. 2015. Wildland recreation: ecology and management. Wiley Blackwell, Chichester, West Sussex, UK
Heinemeyer, K., J. Squires, M. Hebblewhite, J. J. O'Keefe, J. D. Holbrook, and J. Copeland. 2019. Wolverines in winter: indirect habitat loss and functional responses to backcountry recreation. Ecosphere 10:e02611.
International Union for Conservation of Nature (IUCN) and United Nations Environment Programme (UNEP). 2014. The World Database on Protected Areas (WDPA). UNEP-WCMC, Cambridge, UK.
Knight, R. L., and K. Gutzwiller. 1995. Wildlife and Recreationists: Coexistence Through Management and Research. Island Press, Washington, D.C., USA.
Lafferty, K. D., D. Goodman, and C. P. Sandoval. 2006. Restoration of breeding by snowy plovers following protection from disturbance. Biodiversity and Conservation 15:2217–2230.
Larson, C. L., S. E. Reed, A. M. Merenlender, and K. R. Crooks. 2016. Effects of recreation on animals Revealed as Widespread through a Global Systematic Review. PLoS ONE 11: e0167259.

Larson, C. L., S. E. Reed, A. M. Merenlender, and K. R. Crooks. 2018. Accessibility drives species exposure to recreation in a fragmented urban reserve network. Landscape and Urban Planning 175:62–71.

Lesmerises, F., F. Déry, C. J. Johnson, and M.-H. St-Laurent. 2018. Spatiotemporal response of mountain caribou to the intensity of backcountry skiing. Biological Conservation 217:149–156.

Louv, R. 2005. Last child in the woods: saving our children from nature-deficit disorder. Algonquin Books, Chapel Hill, NC, USA.

Lusseau, D. 2005. Residency pattern of bottlenose dolphins *Tursiops* spp. in Milford Sound, New Zealand, is related to boat traffic. Marine Ecology Progress Series 295:265–272.

Lynch, H. J., W. F. Fagan, and R. Naveen. 2010. Population trends and reproductive success at a frequently visited penguin colony on the western Antarctic Peninsula. Polar Biology 33:493–503.

Mancini, F., G. M. Coghill, and D. Lusseau. 2018. Using social media to quantify spatial and temporal dynamics of nature-based recreational activities. PLoS ONE 13:e0200565

Marion, J. L., and S. E. Reid. 2007. Minimizing visitor impacts to protected areas: the efficacy of low impact education programs. Journal of Sustainable Tourism 15:5–27.

McGrann, M. C., G. R. Wright, R. J. Dial, and A. M. McGrann. 2006. Off-highway vehicle impact on the flat-tailed horned lizard, *Phrynosoma mcallii*, in the Colorado Desert of southern California. California Fish and Game 92:67–80.

Monz, C., M. Mitrovich, A. D'Antonio, and A. Sisneros-Kidd. 2019. Using Mobile Device Data to Estimate Visitation in Parks and Protected Areas: An Example from the Nature Reserve of Orange County, California, USA. Journal of Park and Recreation Administration.

Nellemann, C., I. Vistnes, P. Jordhøy, O.-G. Støen, B. P. Kaltenborn, F. Hanssen, and R. Helgesen. 2010. Effects of recreational cabins, trails and their removal for restoration of reindeer winter ranges. Restoration Ecology 18:873–881.

Norman, P., C. M. Pickering, and G. Castley. 2019. What can volunteered geographic information tell us about the different ways mountain bikers, runners and walkers use urban reserves? Landscape and Urban Planning 185:180–190.

Outdoor Industry Association. 2019. Outdoor Industry Association, Boulder. Available from https://outdoorindustry.org/article/outdoor-industry-association-releases-state-by-state-outdoor-recreation-economy-report/ [Sept 2019].

Patten, M. A., J. C. Burger, and M. Mitrovich. 2019. The intersection of human disturbance and diel activity, with potential consequences on trophic interactions. PLoS ONE 14:e0226418.

Patten, M., J. Burger, and M. Mitrovich. 2017. Assessing effectiveness of adaptive recreation management strategies and evaluation of core NCCP/HCP habitat areas. Final report for California Department of Fish and Wildlife Local Assistance Grant #P1482109.

Reed, S. E., and A. M. Merenlender. 2008. Quiet, nonconsumptive recreation reduces protected area effectiveness. Conservation Letters 1:146–154.

Samia, D. S. M., L. M. Angeloni, M. Bearzi, E. Bessa, K. R. Crooks, M. D'Amico, U. Ellenberg, B. Geffroy, C. L. Larson, R. Loyola, A. P. Møller, S. E. Reed, B. Sadoul,

G. Shannon, Z. Tablado, D. Zacarias, and D. T. Blumstein. 2017. Best practices toward sustainable ecotourism. Pages 153-178 *in* D. T. Blumstein, B. Geffroy, D. S. M. Samia, and E. Bessa, editors. Ecotourism's Promise and Peril. Springer International Publishing, Cham, Switzerland.

Schummer, M. L., and W. R. Eddleman. 2003. Effects of disturbance on activity and energy budgets of migrating waterbirds in south-central Oklahoma. The Journal of Wildlife Management 67:789–795.

Shelby, B., T. A. Heberlein, J. J. Vaske, and G. Alfano. 1983. Expectations, preferences, and feeling crowded in recreation activities. Leisure Sciences 6:1–14.

Shively, K. J., A. W. Alldredge, and G. E. Phillips. 2005. Elk reproductive response to removal of calving season disturbance by humans. Journal of Wildlife Management 69:1073–1080.

Sisneros-Kidd, A., A. D'Antonio, N. Creany, C. Monz, and C. Schoenlebner. 2019. Recreation Use and Human Valuation on the Nature Reserve of Orange County, California: 2017 and 2018 Data Collection Summary and Project Report.

Stankowich, T. 2008. Ungulate flight responses to human disturbance: A review and meta-analysis. Biological Conservation 141:2159–2173.

Thomsen, J. M., R. B. Powell, and C. Monz. 2018. A systematic review of the physical and mental health benefits of wildland recreation. Journal of Park and Recreation Administration 36(1):123–148.

Walters, J. R. S. R. Derrickson, D. Michael Fry, S. M. Haig, J. M. Marzluff, and J. M. Wunderle Jr. 2010. Status of the California condor (*Gymnogyps californianus*) and efforts to achieve its recovery. The Auk 127(4):969–1001.

Wang, Y., M. L. Allen, and C. C. Wilmers. 2015. Mesopredator spatial and temporal responses to large predators and human development in the Santa Cruz Mountains of California. Biological Conservation 190:23–33. doi:10.1016/j.biocon.2015.05.007

Yasué, M., and P. Dearden. 2006. The potential impact of tourism development on habitat availability and productivity of Malaysian plovers *Charadrius peronii*. Journal of Applied Ecology 43:978–989.

APPENDIX I: AVAILABLE CONSERVATION PLANNING AND VISITOR USE MANAGEMENT TOOLS

Natural Community Conservation Planning

The Natural Community Conservation Planning (NCCP) Program promotes collaborative planning efforts designed to provide for the region-wide conservation of plants, animals, and their habitats, while allowing for compatible and appropriate economic activity. https://www.wildlife.ca.gov/Conservation/Planing/NCCP

Regional Conservation Investment Strategy Program

The Regional Conservation Investment Strategy (RCIS) Program encourages a voluntary, non-regulatory regional planning process intended to result in high-quality conservation outcomes. The Program consists of three components: regional conservation assessments (RCAs), regional conservation investment strategies (RCISs), and mitigation credit agreements (MCAs). https://www.wildlife.ca.gov/Conservation/Planning/Regional-Conservation

Conservation and Mitigation Banking

Conservation and mitigation banking in California is overseen and undertaken by several Federal and State Agencies. The Banking Program coordinates with other agencies and stakeholders to develop statewide policy and guidance for the establishment and operation of conservation and mitigation banks. https://www.wildlife.ca.gov/Conservation/Planning/Banking

Biogeographic Information and Observation System (BIOS)

BIOS is a system designed to enable the management, visualization, and analysis of biogeographic data collected by the California Department of Fish and Wildlife and its Partner Organizations. https://www.wildlife.ca.gov/Data/BIOS

Areas of Conservation Emphasis (ACE)

ACE is a CDFW effort to analyze large amounts of map-based data in a targeted, strategic way, and expressed visually, so decisions can be informed around important goals like conservation of biodiversity, habitat connectivity, and climate change resiliency. https://www.wildlife.ca.gov/Data/Analysis/Ace

Visitor Use Management (VUM) Framework

VUM is a toolbox for visitor use management and addresses conservation issues. The framework also includes topic areas like capacity, indicators and thresholds, as well as the importance for monitoring recreation use. https://visitorusemanagement.nps.gov/VUM/Framework

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Recreation-related disturbance to wildlife in California – better planning for and management of recreation are vital to conserve wildlife in protected areas where recreation occurs

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Expanding levels of authorized and unauthorized non-consumptive recreation increasingly threaten sensitive biological resources in areas protected primarily or solely to conserve them. As California's human population grows, recreational use in protected areas grows commensurately. The majority of the documented effects on wildlife from non-consumptive recreation are negative; they include detrimental changes in behavior, reproduction, growth, immune system function, levels of stress hormones, and finally, to the survival of individual animals and persistence of wildlife populations and communities. This paper provides insights from the recreation ecology literature into these recreation-related disturbances to insects, amphibians, reptiles, birds, and mammals from hiking, jogging, biking, horseback riding, boating, and off-highway/all-terrain vehicles. The documented evidence of these disturbances to wildlife reveals the flaw in the prevalent assumption that recreation is compatible with biological conservation, the dual-role protected areas' core function. This assumption usually rests on the expectations of (1) allowing only ecologically sound siting of recreational areas and ecologically acceptable types, levels, and timing of recreation, and (2) providing sufficient monitoring, management, and enforcement of recreation to ensure the perpetuation of viable populations of focal sensitive species. However, it is rare that these expectations are met. The ultimate essential outcome of the information provided in this paper is the cessation of the extant recreation-related exploitation of dual-role protected areas. This calls for a societal course change involving: widespread, long-term, and continual multimedia dissemination of the science-based information about recreation-related disturbance to wildlife; application of a science-based approach to siting recreational areas and allowing only ecologically acceptable types, levels, and timing of recreation; and, perpetual personnel and funding explicitly for management at levels commensurate with recreational pressure. These measures would also improve the often cited economic, educational, and recreational/health benefits of dual-role protected areas.

Key words: dual-role protected areas, enforcement, fragmentation, management, multimedia education, non-consumptive recreation, perpetual funding, planning and siting of trail networks, recreational disturbance to wildlife, unauthorized trails

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Conserving habitats is a key strategy for conserving biodiversity worldwide (Pickering 2010). In California, the core function of many areas protected for conservation is to ensure the perpetuation of sensitive species (i.e., species whose persistence is jeopardized), as is appropriate for the nation's most biologically diverse state (CDFW 2015). The level of land conservation that California enjoys is intended to ensure that the state's globally renowned biodiversity remains intact. However, of all the states in the USA, California hosts the most listed species imperiled by recreation, in part because the strongest association of outdoor recreation is with urbanization (Czech et al. 2000), which is itself an important cause of endangerment (Reed et al. 2014). The anticipated growth of the state's human population from approximately 38 million in 2013 to 50 million by mid-century with a commensurate increase in recreational demands in protected areas will likely increase the continual challenge of conserving the state's wildlife (CDFW 2015).[1, 2] The dual role of protected areas to conserve biodiversity and provide nature-based recreational and educational opportunities for millions of people rests on the assumption that non-consumptive recreation is compatible with wildlife conservation, despite documented evidence to the contrary (Reed and Merenlender 2008; Larson et al. 2016; Hennings 2017; Dertien et al. 2018; Reed et al. 2019).[3] Ecologically sound types, levels, timing, and siting of recreation, and perpetual management of recreation at or exceeding a level commensurate with the recreational pressure, are vital to ensure the perpetuation of viable populations of focal sensitive species in "dual-role" protected areas.[4, 5]

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[1] Protected areas include locally-owned lands (e.g., county and city reserves), state-owned lands (e.g., ecological reserves, wildlife areas, state parks), federally owned lands (e.g., national wildlife refuges, wilderness areas), and privately owned lands (e.g., conservation easements, conservancy lands, mitigation banks and lands). Here, the focus is on protected areas preserved primarily or solely for the perpetuation of sensitive species (e.g., ecological reserves, protected areas established pursuant to Natural Community Conservation Plans and/or Habitat Conservation Plans, mitigation banks and lands).

[2] Wildlife means all wild animals: insects, fish, amphibians, reptiles, birds, and mammals.

[3] In contrast to consumptive recreation (e.g., hunting, fishing), non-consumptive recreation is generally assumed not to directly extract a resource; it includes nature and wildlife viewing, beach-going, kayaking, hiking, biking, horseback riding, and wildlife photography (Reed and Merenlender 2008; CDFW 2016; Gutzwiller at el. 2017). From here forward, "recreation" means non-consumptive recreation, unless otherwise stated.

[4] Focal species are organisms whose requirements for survival represent factors important to maintaining ecologically healthy conditions; identified for the purpose of guiding the planning and management of protected areas in a tractable way, focal species include keystone species, umbrella species, flagship species, and indicator species (Soulé and Noss 1998; Marcot and Flather 2007). Here, the term "focal species" is intended to include those species encompassed by the guild surrogate approach of conservation; this approach entails one member or a subset of members serving as a surrogate for other members of the guild (Marcot and Flather 2007).

[5] From here forward, "management" includes monitoring, management, and enforcement with the necessary authority. The level of enforcement necessary is dependent on the level of continual management implemented; generally, the more the management, the less enforcement is necessary. In addition, monitoring and management encompass both the natural resources and human users of the protected areas. The fiscal support to be secured includes personnel and all program costs.

Insights from studies

Purpose.—The purpose of the following discussion is to provide insights to disturbances to several wildlife species from non-consumptive recreation. Accordingly, the insights are exclusively from studies that document recreation-related disturbance to wildlife. This approach reflects the evidence that the majority of documented responses of wildlife species to non-consumptive recreation are negative, as demonstrated in two systematic literature reviews (Reed et al. 2014; Larson et al. 2016) and a literature review of over 500 articles written and reviewed by the scientific community (Hennings 2017). The insights are intended to (1) illustrate that scientific studies provide clear evidence of recreation-related disturbance to wildlife, (2) elicit awareness of and concern about the disturbance, and (3) stimulate action to address it.

Sources and scope.—The 71 articles and 13 reports[6] reviewed about the recreation-related effects on wildlife generally reflect Larson et al.'s (2016) finding that studies about such effects focus on mammals (42%) and birds (37%), followed by invertebrates (12.4%), reptiles (5.5%), fish (5.1%), and amphibians (0.7%); there are no insights herein from studies of fish. Larson et al. (2016) found that some of the least-studied taxonomic groups (i.e., reptiles, amphibians, and invertebrates) had the greatest evidence for negative effects of recreation. While not all the studies selected for this paper address wildlife in California, all the studies' scenarios could occur in the state as do all species types among the studied taxa (i.e., insect, amphibian, reptile, bird, mammal).

Not all of the studies selected for this paper address sensitive species. This is primarily because current research on recreation-related effects on wildlife includes few species of conservation concern (Larson et al. 2016). However, sensitive species may experience greater levels of recreation-related disturbance than described for common species in the study insights herein. This is because many rare and isolated species are specialists, and they may be more sensitive to anthropogenic disturbance, including recreational activities, than common and widely distributed species (Bennett et al. 2013; Reilly et al. 2017). Recreation-related declines of common species warrant attention because of their functional ecological importance – local depletions of common species can have broad consequences within the food web (Säterberg et al. 2013; Baker et al. 2018; Reed et al. 2019). Recreation-related declines or disturbance in an important common prey species may affect the species in higher trophic levels (Reed et al. 2019). More than a quarter of species become functionally extinct before losing 30% of their individuals (Säterberg et al. 2013; Baker et al. 2018; Reed et al. 2019); here, functional extinction occurs when the population size of the depleted species is below the level at which another species goes extinct (Baker et al. 2018).

The scope of this paper does not include studies about snow-based recreation, though all of the 14 articles addressing snow-based recreation that Larsen et al. reviewed reveal that non-motorized and motorized snow-based activities (i.e., skiing, snowshoeing, snowmobiling) can have significant negative effects. Nor does the scope of this paper include studies exclusively about the effects of dogs on wildlife; however, a literature review on the effects of dogs on wildlife concludes that (1) people with dogs on leash, and even moreso

[6] All the articles are published in peer-reviewed journals. Some of the reports were peer reviewed and all were written by or contributed to by professionals in the fields of biology or ecology, though none of the reports were published in peer-reviewed journals to this author's knowledge (e.g., Burger 2012; Hennings 2017; Dertien et al. 2018; Reed et al. 2019). This paper does not cite all the articles and reports this author read. And, the totals exclude documents that are not explicitly about recreation-related effects on wildlife (e.g., Tinkler et al. 2019; Taff et al. 2019; Wolf et al. 2019) and all newspaper articles.

off leash, are more alarming and detrimental to wildlife than any non-motorized recreational user group without dogs, and (2) people with dogs substantially increase the amount of wildlife habitat affected (Hennings 2016). Hennings (2016) also asserts that wildlife does not appear to habituate to the presence of dogs; effects linger after dogs are gone because the scent of dogs repels wildlife.

Management measures.—The study insights focus on the documented recreation-related disturbance to wildlife, not on management measures to prevent or minimize the disturbance. However, many of the reviewed articles and reports identify such measures, which range from full prohibition of human access, to time-of-access restrictions (e.g., seasonal or diurnal/nocturnal restrictions), to various measures based on disturbance thresholds. Disturbance thresholds are thresholds of various measurable parameters above or below (depending on the parameter) which wildlife is disturbed. Examples of disturbance thresholds are distance between trails and nesting sites, density of active trails, number of recreationists, number of recreational events per time frame, and duration of recreation. These thresholds may be used to establish management measures such as minimum widths of spatial buffers between recreational trails and wildlife.

A common theme among the management measures is that continual proactive and adaptive management is needed to protect wildlife from recreational disturbance, and that access closures should occur if the management fails.[7] Adaptive management is a cornerstone of large-scale multi-species conservation (CDFW 2014). An example of proposed management measures is Dertien et al.'s (2018) recommendation for a precautionary approach that adopts maximum values of quantitative disturbance thresholds observed for the taxa of concern, while excluding the extreme values of the thresholds.[8] This approach stems from the gaps in knowledge about quantitative disturbance thresholds of recreation; such thresholds are lacking for many species, taxonomic groups, and sources of disturbance.

Regarding spatial buffers, a general rule of minimum thresholds for distance to trails cannot be established for some species, as individual variability within species can be high and can differ among populations, types of topography, and frequencies and types of human intrusion (González et al. 2006). For example, Dertien et al. (2018) recommended a 200-m minimum buffer for ungulates; however, this would be insufficient for the circumstances of Taylor and Knight's (2003) study further cited below in which they found that mule deer (*Odocoileus hemionus*) showed a 96% probability of flushing within 100 m of recreationists located off trails, and the probability of their flushing did not drop to 70% until perpendicular distance reached 390 m. Two additional factors that influence the determination of spatial buffers are "effect zones" (i.e., areas within which wildlife is disturbed by recreational ac-

[7] Based on section 13.5 of the California Fish and Game Code and the Natural Community Conservation Planning Act (i.e., section 2805 of Fish and Game Code), adaptive management generally means (1) improving management of biological resources over time by using new information gathered through monitoring, evaluation, and other credible sources as they become available, and (2) adjusting management strategies and practices accordingly to assist in meeting conservation and management goals (e.g., conservation of covered or focal species). Under adaptive management, program actions are viewed as tools for learning and to inform future actions.

[8] The central tenet behind the precautionary principle is that precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically. Generally, the four central components of the principle are: taking preventive action in the face of uncertainty; shifting the burden of proof to the proponents of an activity; exploring a wide range of alternatives to possibly harmful actions; and increasing public participation in decision making (Kriebel et al. 2001). There are subtle differences between the precautionary principle and precautionary approach, but their consideration is beyond the scope of this paper.

tivities on trails) and the density of the trail networks. The effect zones can extend several hundred meters on either side of the trails (Reed et al. 2019). The smaller a protected area is and the denser its trail networks are, the greater the proportion of the protected area is occupied by effect zones, and the less likely it is that spatial buffers such as those Dertien et al. (2018) recommended will protect the focal species from recreational disturbance (Wilcove et al. 1986; Ballantyne et al. 2014).

There are many sources that provide information about management of recreation in protected areas, or guidance on the design or siting of trails/trail networks. These sources include management framework tools designed to address recreational use, though they vary in their attention to the needs of wildlife (Hennings 2017).

Insects

In a study of the effects of walkers, runners, and runners with dogs on the federally endangered Karner blue butterfly (*Lycaeides melissa samuelis*; Karners) at the Indiana Dunes National Lakeshore, USA, Bennett et al. (2013) found that (1) Karners flushed in the presence of recreationists as they would respond to natural agents, such as predators; (2) recreation restricted host-plant choice by reducing host-plant availability, effectively rendering the quality of habitat within 10 m of the trail unsuitable; (3) recreation had the potential to reduce oviposition rate of virtual females by 50%, and therefore population growth rates; (4) the frequency at which recreationists negatively affected the females (including their oviposition) varied substantially with habitat extent, number of recreationists, and sensitivity; and (5) habitat extent was the primary predictor variable. The authors concluded that Karners will experience less recreation-related disturbance the farther their habitat extends beyond trails.

In a study conducted near Palo Alto, California, USA focusing on 10 native oak woodland species of butterflies, Blair and Launer (1997) concluded that even small perturbations by hikers and joggers in a recreational area led to (1) a loss in the number of butterfly species (species richness) of the original oak-woodland community compared to the number of these species in a biological preserve with no recreation, and (2) a lower number of butterflies (abundance) in the recreational area compared to the biological preserve. The authors also concluded that multi-use areas may not adequately preserve butterfly species diversity.

Herpetofauna

Responses of the Iberian frog to recreational activities.—In a study involving field research in the Guadarrama Mountains in central Spain and simulation modelling to assess the effects of recreation on Iberian frogs (*Rana iberica*), an endemic species in decline, Rodríguez-Prieto and Fernández-Juricic (2005) measured frog abundance and response to human disturbance. The authors found that Iberian frog abundance (a population-level parameter): (1) was significantly affected mainly by study site location and distance to the nearest recreational area, a proxy for human disturbance; (2) was positively related to distance from recreational area (i.e., as distance decreased, abundance decreased); and (3) increased as number of humans decreased. With respect to the effects of repeated disturbances (e.g., human approaching with a steady pace) on the individual-level parameters of

flight initiation distance[9] and time to resume pre-disturbance activities, the study showed that: (1) frogs' flight initiation distances were longer in areas with less vegetation cover; (2) though the flight initiation distances did not vary with repeated human approaches, the number of repeated human approaches affected the frogs' time to resume pre-disturbance activities, with second and third approaches increasing the time it took frogs to reoccupy the disturbed spot; and (3) there was an 80% decrease in the frogs' stream-bank use with a 5-fold increase in the direct disturbances per hour, and a 100% decrease in stream bank use with a 12-fold increase in human disturbances per hour. The authors concluded that direct human disturbance affects this species at the population level, and that it needs to be considered as a potential factor affecting amphibian populations with low tolerance for disturbance.

Responses of the yellow-blotched map turtle to human disturbance.—In a study along a 300-m reach of the Pascagoula River in southeastern Mississippi, USA, Moore and Siegel (2006) studied the effects from boating, fishing, jet skis, and direct anthropogenic damage to nests on the nesting and basking behavior of the yellow-blotched map turtle (*Graptemys flavimaculata*), listed as threatened under the U.S. Endangered Species Act. With respect to human disturbance of nesting turtles, the authors found that numerous turtles waited several hours near a sandbar before emerging from the water onto the beach to nest, and turtles that attempted to nest upon emerging onto the beach frequently abandoned their efforts and retreated to the water—of a total of 79 nesting attempts, only 15 successfully completed oviposition. With respect to human disturbance of basking turtles, the authors found that the number of turtles disturbed differed significantly with the type of disturbance; specifically, anglers that remained in the basking vicinity caused the most disturbance, and jet-skis caused less than an expected amount of disturbance; this was likely because of the anglers' closeness (compared to the jet-skis) to the basking logs and the long periods they remained, both of which caused turtles to bask less. Moore and Siegel (2006) concluded that: the interruption of nesting activities may have a severe impact on the viability of this population of turtles through changes in numbers of clutches; and, the interruption of basking and consequent reduction in the turtles' body temperature has the potential to negatively affect the ability of all turtles to process and digest food, and the ability of females to develop eggs during the reproductive seasons.

Responses of the common wall lizard to tourism.—In a study of common wall lizards (*Podarcis muralis*) conducted in areas with high and low levels of tourism within the same habitat in the Guadarrama Mountains in central Spain, Amo et al. (2006) examined whether the lizards differed in several parameters upon each human approach. The authors found that: (1) regardless of the level of tourism, lizards usually exhibited anti-predator behavior by fleeing to hide in refuges upon approach of a human; (2) in comparison to lizards inhabiting areas of low tourism pressure, lizards inhabiting areas with high tourism pressure, and therefore presumably escaping to hide in refuges more often, showed a poorer body condition and higher intensity of tick infection at the end of the breeding period; and (3) the intensity of tick infection was higher in male than in female lizards. The authors speculated that the higher intensity of infection probably resulted from the cumulative costs of high frequency of flight, since anti-predatory behaviors such as flight are costly in terms of losing time for other activities, including feeding—nutritional status can affect the capacity

[9] The flight initiation distance is the distance from an approaching threat (e.g., recreationist) at which an animal initiates moving away to escape from the threat. This movement is a fitness/energy cost to the fleeing animal. For the Iberian frogs, this was the distance between an approaching human and the frog when the latter jumped into the water in response to the human's approach.

of lizards to mount an immune response to infection. Furthermore, lizards with poor body condition had low levels of immune response, which may aggravate the deleterious effects of anti-predatory behavior on body condition. Female lizards in poor body condition produced offspring of small size, and body size of infant lizards can affect their probability of survival. Additionally, females with blood parasites also showed reduced fat stores and produced smaller clutches. By these effects on infants and clutch sizes, tourism may also negatively affect the maintenance of lizards' populations.

Responses of various reptiles to recreationists.—In a study to systematically assess recreationists' direct and indirect effects on sensitive wildlife species in 14 NCCP/HCP protected areas in San Diego County, California, USA, Reed et al. (2019) integrated monitoring of both wildlife species and recreationists (e.g., hikers, mountain biker, horseback riders).[10] The authors found that recreation was associated with declines in reptilian species' richness, occupancy, habitat use, and relative activity in the NCCP/HCP protected areas. Of the three species (all lizards) for which statistical analyses were feasible, two exhibited negative relationships between occupancy and human recreation—the orange-throated whiptail (*Aspidoscelis hyperythra beldingi*, an NCCP/HCP-covered species) and common side-blotched lizard (*Uta stansburiana*).

Birds

General responses.—In Steven et al.'s (2011) review of 69 peer-reviewed articles (50 of which were research conducted in protected areas) of original research on the effects on birds from non-motorized nature-based recreation, 61 articles reported recreation as having negative effects (i.e., negative changes in physiology, behavior, abundance, and reproductive success, the latter including the number of nests, eggs laid, and/or chicks hatched or fledged). The single documented positive effect involved an increase in the abundance of corvids (e.g., crows and ravens) in campgrounds. Walking or hiking, standing or observing birds from viewing platforms or standing next to a nesting colony, dog walking, running, cycling/mountain biking, and canoeing were all reported as negatively affecting birds. A large majority (85–93 %) of the studies that examined the effects of a single person, groups of two or more people, and/or avian population-level responses, reported negative effects. The population-level responses entailed effects on density, abundance, and reproduction.

In a study using data collected in 112 urban parks throughout Melbourne, Australia, Bernard et al. (2018) tested whether birds responded differently to bikers and walkers. They found that: (1) relative to their response to walkers, four of the 12 focal species studied initiated escape from bikers at longer flight initiation distances and two escaped with greater intensity (i.e., more likely to involve flying); (2) no species responded less to bicycles than to walkers; and (3) the flight initiation distance did not differ in response to speed of bicycle travel, though the difference in the two speeds used was only 1 m/sec. In concluding that

[10] An NCCP (Natural Community Conservation Plan) is a comprehensive, single- or multi-jurisdictional/utility plan that provides for regional habitat and species conservation at an ecosystem level while allowing local land use authorities to better manage growth and development. Upon issuing an NCCP Permit, the California Department of Fish and Wildlife (CDFW) can authorize take of selected state listed species and other species of concern, subject to the terms of coverage under the NCCP (CDFW 2015). An HCP (Habitat Conservation Plan) is the federal counterpart to an NCCP; the U.S. Fish and Wildlife Service prepares HCPs and issues HCP permits. The terms and conditions under which an NCCP/HCP's protected areas are conserved establish the types and levels of public access that are permitted (Burger 2012). The types and levels of public access vary among the NCCP/HCP protected areas from no access to guided-only access to open access. The species protected by NCCPs/HCPs are typically called covered species.

bikers can appear more or less threatening to birds than a single pedestrian, Bernard et al.'s (2018) results underscore that the responses of wildlife to recreational activities vary among species, sites, types of recreation, and exposure over time to the activities.

Songbirds.—Davis et al.'s (2010) study of the effects of mountain biking on golden-cheeked warblers (*Dendroica chrysoparia*, warblers) with nests near biking trails in the Fort Hood Military Base in Killeen, Texas, USA, and the Balcones Canyonlands Preserve in Austin, Texas, found direct and indirect effects. The direct effects included warblers flushing >20 m in response to encounters with passing mountain bikers. Indirect effects included abandonment of nests <2 m from the biking trails and a reduction in the quality of nesting habitat due to biking-related fragmentation and alteration of habitats. In comparison to the control sites, it was likely that habitat fragmentation resulting from trails in the biking sites caused the increased predation of warbler nests by rat snakes (*Elaphe obsoleta*) and other edge-adapted predators. The authors speculated that the biking sites, which were able to maintain viable populations of warblers at the time of the study, may not continue to do so with additional recreational use, fragmentation, and alteration of the habitats.

Forest birds.—Bötsch et al. (2018) examined how breeding-bird communities changed with distance to trails in four broad-leafed and mature forests in Switzerland and France; the forests were similar in size, structure, and trails, but widely different in levels of recreation (mostly walkers). The authors found that: in the forests with high levels of recreation, the density and species richness of birds decreased by 12.6% and 4.0%, respectively, at points close to trails compared to points farther away; cavity, ground, and open-cup nesters had fewer territories and species close to trails compared to farther away; and, above-ground foragers and ground foragers showed a similar pattern. None of these effects on density, species richness, nesting guild, or foraging guild occurred in the forests with low levels of recreation. Both high- and low-sensitivity species (i.e., long versus short flight initiation distances) had fewer territories and fewer species close to versus far from trails in forests with high levels of recreation; however, in forests with low levels of recreation, highly sensitive species exhibited only a slight tendency for fewer territories close to trails. The authors inferred from their findings that (1) human presence in forests disturbs avian community composition and abundance along trails in recreational areas, (2) the overall effect of recreational trails themselves depends mainly on recreational intensity and only slightly on species characteristics, and (3) the observed effects on birds in forests where recreation has occurred for decades suggest that habituation to humans has not outweighed the effects.

Raptors.—In a study along the Boise River in Idaho, USA, examining flight initiation distances of bald eagles (*Haliaeetus leucocephalus*) in response to actual and simulated walkers, joggers, anglers, bikers, and vehicles, Spahr (1990) found that the highest frequency of eagle flushing was associated with walkers, followed by anglers, bikers, joggers, and vehicles. Eagles were most likely to flush when recreationists approached slowly or stopped to observe them, and were less alarmed when bikers or vehicles passed quickly at constant speeds. However, the longest flight initiation distance was in response to bikers, followed by vehicles, walkers, anglers, and joggers. Hennings' (2017) literature review provides the following about bald eagles: pedestrians within 275 m caused a 79% eagle response rate; eagles did not resume eating for four hours after disturbance by walkers; a suggested minimum 600-m buffer around breeding eagles, beyond which response frequency dropped below 30%; an apparent threshold of about 20 daily recreational events after which eagles were slow to resume feeding, and after 40 events, feeding was uncommon; sub-adults were

less tolerant of disturbance than adult eagles; and recreation-related long-term effects can include reductions in survival, particularly during winter and especially for juveniles.

With respect to the tolerance (through habitat imprinting, genetic inheritance, or habituation) of golden eagle (*Aquila chrysaetos*) for recreational disturbance, Pauli et al. (2017) used an individual-based model[11] to assess the effects of walkers and off-highway vehicles on golden eagle populations. The primary modeling results indicated that, while golden eagles can develop tolerance for recreational disturbance, tolerance for even moderate levels of disturbance may not develop within a population at a sufficient rate to offset the effects of increased recreation on breeding golden eagles, particularly because this is a long-lived species with low recruitment. Pauli et al. (2017) conclude that, taken together, the simulation results suggest that recreation-related disturbance has a substantial effect on golden eagle populations and that increased recreation activity will exacerbate such effects. Given the results and the fact that non-motorized recreation decreases the probability of egg-laying in golden eagles (Spaul and Heath 2016), the authors asserted that trail management and a reduction in recreation activity within eagle territories are necessary to maintain golden eagle populations in locations where levels of recreation are increasing.

Shorebirds.—In a controlled study conducted in Scotland of the behavioral responses of the ruddy turnstone (*Arenia interpres*) to an approaching human, Beale and Monaghan (2004) found that birds supplemented with food flushed sooner from the human and searched for predators more frequently than birds not supplemented with food. That is, birds responding most were actually the least likely to suffer any fitness consequences associated with the disturbance. This study demonstrates the possibility of misconstruing the reasons for and implications of observed responses among all wildlife species. Traditionally and intuitively, species that readily flee from or avoid human disturbance are considered to be the most in need of protection from disturbance. However, species with little suitable habitat available nearby cannot show marked avoidance of disturbance even if the costs of reduced survival or reproductive success are high, whereas species with many nearby alternative sites to move to are likely to move away from disturbance even if the costs of the disturbance are low (Gill et al. 2001). It should not be assumed that the most responsive animals are the most vulnerable (Beale and Monaghan 2004). Gill et al. (2001) asserted that the absence of an obvious behavioral response does not rule out a population-level effect. In the same vein, it may be that species occurring in protected areas that are remnant fragments within urban landscapes are forced to utilize all components of the fragments, irrespective of their land-use intensity and land cover. This may occur if animals have nowhere else to go, and may be an explanation for instances when the relative abundance of birds is greater in urban and suburban reserves than in exurban reserves (Markovchick-Nicholls et al. 2008).

Mammals

General responses within NCCP/HCP protected areas in southern California.—In series of three studies about the responses of mammals to hikers and runners, bikers, horseback riders, dog walkers, and motorized vehicles, George and Crooks (2006), Patten et al. (2017), and Patten and Burger (2018) analyzed camera-trap data captured throughout areas protected under the 1995 County of Orange Central and Coastal NCCP/HCP (Orange County NCCP/HCP). All studies analyzed bobcat (*Lynx rufus*), coyote (*Canis latrans)*, and mule

[11] Individual-based models are simulation statistical tools that use empirical data to examine effects, such as anthropogenic population-level effects, that are difficult or impossible to study in a field setting.

deer, and Patten et al.'s (2017) analysis also considered mountain lion (*Puma concolor*), gray fox (*Urocyon cinereoargenteus)*, striped skunk (*Mephitis mephitis*), and northern raccoon (*Procyon lotor*). The authors found that: (1) mammal detections were negatively correlated with all types of recreationists; hikers and runners had the greatest negative association with wildlife, and equestrians had the least; (2) the overall trend is sharply negative: as human activity increased, mammalian activity decreased, regardless of species, type of human activity, or camera placement; (3) mammals were nearly four times as likely to be recorded on days with no human activity than on days with human activity at the same site; (4) detections of mammals decreased incrementally as the number of humans increased within a day, and fell to near zero probability at ≥60 humans per day; and (5) all seven species listed above exhibited short-term spatial displacement in response to events with more than 100 visitors.

Bobcats' negative associations were strongest with bikers, hikers, and domestic dogs. In areas of higher human activity, bobcat were detected less frequently along trails and appeared to show temporal displacement, becoming more nocturnal. Coyotes' overall activity was lower at the sites with the most recreation and was negatively associated with overall human, hiker, and biker visitations; and, a trend of temporal displacement in response to dogs was also evident. Generally, both bobcats and coyotes displayed a relatively wide range of activity levels at sites with low human use, but a lower and markedly restricted range of activity at those sites with the highest levels of recreation. Both coyotes and mule deer shifted their activities temporally over the long term. The mule deer's (a primary consumer) marked shift brought it into closer temporal alignment with its main predator (mountain lion) and the coyote's marked shift (secondary consumer) brought it into closer temporal alignment with a chief prey species (gray fox). These human-induced diel shifts involving animals in two trophic levels have important ramifications for predator–prey dynamics. Despite these studies' results, no evidence was found suggesting mammalian populations have declined in the Orange County NCCP/HCP protected areas between 2007 and 2016, even as human activity increased markedly across the study period. However, it is critical to consider this observation in light of: (1) the fact that, at least for the years 2007-2011, public access was controlled across most of the study area by permit-only entry, regular docent-led programs, and monthly self-guided wilderness access days—much higher levels of restrictions on public access than for most protected areas; (2) the authors' assertion that various mammalian species' avoidance behavior may yet drive mammalian populations downward upon further increase in human disturbance; and (3) the status of the Vail Colorado elk herd as recounted below—once a herd of 1,000 head diminished to 53 due to steadily increasing levels of recreation.

Overall, the results of the above three studies were similar to those of a study to assess recreationists' effects on sensitive wildlife species in 14 NCCP/HCP protected areas in San Diego County, for which Reed et al. (2019) used data from camera traps and a before-after-control-impact (BACI) experiment. Reed et al. found that bobcat, gray fox, mule deer, and northern raccoon were less active in areas with higher levels of human recreation. Bobcat habitat use was more strongly negatively associated with human recreation than urban development, which also decreased the probability of habitat use. The collective results for mule deer among the four studies suggest that mule deer may stop using some areas altogether if human recreation is too high. Reed et al. (2019) did not detect negative associations between human recreation and the habitat use or relative activity of the six following mammalian species of the 12 observed: coyote, striped skunk, ground squirrel, jackrabbit, brush rabbit

(*Sylvilagus bachmani*), and desert cottontail (*S. audubonii*). However, of special note are results from the protected area with the highest level of recreation (i.e., an average of 1,797 people per day) observed in the study, where the cameras captured only rabbits, and no other mid- to large-bodied wildlife species during 7.5 weeks of monitoring. Yet, this 2,449-ha protected area is considered a core biological area and regional wildlife corridor targeted for conservation (City of San Diego 2019). The BACI experiment conducted in another protected area showed a significant decrease in bobcat detection probability in a four-week period following a trail re-opening, suggesting that this species can modify its behavior (e.g., shift its activity patterns) rapidly after a change in human recreation. This is evidence that temporal closures have the potential to reduce disturbance during critical periods for some species. Although human recreation may not often extirpate mammalian species from urban habitat fragments, it can reduce habitat suitability and carrying capacity (Reed et al. 2019).

Responses to human voice.—Suraci et al. (2019) tested whether mammalian carnivores' responses to human voices alone can result in landscape-scale effects across wildlife communities, including cascading effects on the behavior of lower trophic level animals. The results of the study, which was conducted in the Santa Cruz Mountains of central California, USA, indicate that human voice alone does result in such effects. Where humans are absent or rare, large and medium-sized carnivores exhibit greater movement, activity, and foraging, while small mammals use less space and forage less. Where humans are present, the activity, foraging, and/or habitat use of large and medium-sized carnivores are suppressed, while small mammals increase their total space use and foraging intensity. The implications of these results are far-reaching, and include that, even in the absence of land development or habitat fragmentation, increased human presence can: (1) affect large carnivore movement, which could eventually limit carnivores' hunting and feeding behavior or force individuals to abandon high risk areas of their home range; (2) suppress activity of medium-sized carnivorous species; and (3) increase the abundance of small mammals that are prey to the large- and medium-sized predators, which could ultimately increase the abundance of small mammals in wildlife areas people visit (Suraci et al. 2019, citing other authors). Moreover, if the sublethal effects observed in the study in response to human voices alone are comparable to those effects (e.g., increased physiological stress, reduced reproductive success) that fear has been demonstrated to cause in predator-prey systems, they may amount to additional widespread but largely unmeasured effects of humans on wildlife populations (Suraci et al. 2019, citing other authors). Hennings (2017) provides additional insights about, and citations for studies on, the effects on wildlife from the human voice, concluding that conversational noise along trails can be very disturbing to wildlife.

Ungulates.— In a two-year study of elk (Cervus elaphus) in a herd near Vail in central Colorado, USA, Shively et al. (2005) found that elk reproductive success rebounded to pre-disturbance levels after the cessation of their exposure to back-country hikers during the calving season over the previous three years. Shively et al. concluded that, it seems prudent to protect elk during calving seasons, because, although the study provides evidence that elk reproduction can rebound from depressed levels when human disturbances are removed or reduced, there had been a linear decline in calf production in response to increasing levels of disturbance compared to controls without such disturbance, and it is not known if there is a threshold level of reproductive depression from which elk cannot recover. Recognizing that it is seldom easy to curb human activities that have become traditional, or to restore wildlife habitats once they have been developed, they recommended the continuation of

some closures imposed on parts of both the Vail and control elk herd study areas. However, a recent article in The Guardian reported that the number of elk in this same Vail herd dropped precipitously since the early 2010s with the steady increase in human recreation; once a herd of 1,000 head of elk, it had decreased to 53 at last count in February of 2019. The article explains that, for Bill Alldredge, one of the authors of the 2005 study, there is no other explanation than the increased levels of hiking, biking, and skiing in the area that supports this elk herd (Peterson 2019). This outcome adds to the already ample evidence that pregnant animals or those with young—especially mammals—are particularly sensitive to human disturbance (Hennings 2017).

In a study subjecting 13 captive female elk in the Starkey Experimental Forest and Range in Oregon, USA, to four types of recreational disturbances (all-terrain vehicles [ATV] riding, mountain biking, hiking, and horseback riding), Naylor et al. (2009) recorded the elk's resting, feeding, and travel times in response to the disturbances. The authors found travel time (a proxy for energy expense) increased in response to all four disturbances and was highest in mornings. The authors suggest that the elk's lesser response to each disturbance in afternoons was likely due to elk moving away from the disturbances in the mornings and avoiding them for the remainder of the day. Elk travel time was highest and feeding time lowest during ATV exposure, followed by exposure to mountain biking, hiking, and horseback riding. Resting decreased with exposure to mountain biking and hiking disturbance, and elk showed no evidence of habituation to mountain biking or hiking.

In a study of how bison (*Bison bison*), mule deer, and pronghorn (*Antilocapra americana*) responded to hikers and bikers on designated recreational trails at Antelope Island State Park in Great Salt Lake, Utah, USA, Taylor and Knight (2003) found the following: with respect to alert distance, flight initiation distance, and distance moved,[12] there was little difference in how each species responded to hikers versus mountain bikers (with an exception of mule deer flight distance), though each species exhibited its own degree of response in the three parameters tested; and all three species exhibited a 70% probability of flushing from on-trail recreationists within 100 m from designated trails. Trials were also conducted with only mule deer along a randomly chosen, off-trail route to assess the response of mule deer to hikers or bikers off designated trails. From these trials, the authors found that mule deer showed a 96% probability of flushing within 100 m of recreationists located off trails, and the probability of their flushing did not drop to 70% until perpendicular distance reached 390 m. There was little evidence of habituation to recreationists among the species at the time of the study. In fact, the pronghorn at the study site did not habituate to largely predictable recreational use over a three-year period following the opening of trails at the site, and used areas that were significantly farther from trails than they had prior to the start of recreational use.

Carnivores.—In a study of mammalian carnivores in 28 protected areas located in oak woodlands in northern California, USA, Reed and Merenlender (2008) found the following about carnivores' responses to recreationists. Generally, in paired comparisons of neighboring protected areas with and without recreation, the presence of dispersed, non-motorized recreation (hiking, biking, and horseback riding) led to a five-fold decline in the

[12] Alert distance is the distance from a stimulus at which an animal initiates vigilance behavior; more specifically in this context, it is the distance between a recreationist and an animal when the animal first becomes visibly alert to the recreationist. Flight initiation distance is defined in footnote #9. Distance moved is the distance an animal travels from its initial position until it stops (Taylor and Knight 2003).

density of native carnivores and a substantial shift in community composition from native to nonnative species. Specifically, a higher mean number of native species was detected in protected areas that did not permit recreation. By contrast, in protected areas that permitted recreation, more nonnative species were detected, domestic dogs were detected more frequently, and densities of coyotes and bobcats were more than five times lower. The authors concluded that the key variable for moderately sized protected areas (50–2000 ha) near urban development seems to be whether or not the site is open to public access.

In a study within three protected areas in Arizona, USA, Baker and Leberg (2018) found the following about how 11 mammalian carnivore species respond to varying levels of hiking, horseback riding, and border patrol activity. The study sites with the highest levels of human activity had significantly lower carnivore diversity, higher occupancy of common species (coyote, gray fox, and bobcat), and lower occupancy of all other carnivorous species. Generally, rare carnivores (e.g., mountain lion and kit fox, *Vulpes macrotis*), badgers (*Taxidea taxus*), and gray foxes avoided trails, whereas common species (except gray fox) preferred trails. Overall, edges of protected areas appeared to negatively affect occupancy of nearly all the study's species, and the presence alone of roads and trails, and not necessarily how much they are used, has a significant negative effect on the occupancy of most carnivorous species. In general, coyotes and bobcats were the carnivores least sensitive to human disturbance, gray foxes had a moderate negative association with human disturbance variables, and smaller carnivores and mountain lions seemed to be exceptionally vulnerable to human disturbance. Furthermore, the higher the level of overall disturbance in a protected area, the more sensitive carnivores were to disturbance variables.

Conclusions and Suggestions

With the expanding recreation-related disturbance to wildlife in protected areas, their dual role of conserving biological resources and providing nature-based recreational and educational opportunities for people presents a continual challenge to land managers and a continual threat to wildlife and the state's biodiversity, particularly sensitive species. The scientific literature provides clear evidence that recreation can disturb wildlife in several ways. Documented effects include detrimental changes to behavior, reproduction, growth, immune system function, levels of stress hormones, other physiological effects, and finally, the survival of individual animals and persistence of wildlife populations and communities. Having been observed on nearly every continent and in every major ecosystem on earth, recreation-related disturbance to wildlife is increasingly recognized as a threat to global biodiversity, and as having wide-ranging and, at times, profound implications for wildlife individuals, populations, and communities (Dertien et al. 2018). Yet, a prevalent assumption exists that non-consumptive recreation is compatible with wildlife conservation; sources that articulate this assumption in various ways include but are not limited to the Natural Community Conservation Plans/Habitat Conservation Plans (NCCPs/HCPs in the California Department of Fish and Wildlife's (CDFW) South Coast Region, Title 14 of the California Code of Regulations (§630(a)) about CDFW's ecological reserves, CDFW's 2016 State Wildlife Action Plan's Consumptive and Recreational Uses Companion Plan, Burger 2012, Larson et al. 2016, Dertien et al. 2018, and Reed et al. 2019. This assumption underlies the widespread acceptance of non-consumptive recreation in dual-role protected areas.

Is the assumption of compatibility flawed?—The assumption of compatibility rests on four expectations, which are often legal obligations (as with NCCPs/HCPs). First, recreation in protected areas is to occur only in ecologically sound locations. Second, only ecologically sound types, levels, and timing of recreation are acceptable. Third, monitoring is expected to regularly and reliably assess whether the types and levels of recreational activities in protected areas are disturbing the focal species to a degree that these activities should be curtailed or prohibited entirely. Fourth, changes in management are to occur promptly when monitoring determines them to be necessary (see footnote #5 for description of management). In short, the overarching expectation is that recreation would not hinder the achievement of the dual-role protected areas' primary conservation objective (i.e., perpetuation of viable populations of focal sensitive species). At least seven NCCPs/HCPs in the CDFW's South Coast Region explicitly deem recreation compatible or conditionally compatible; most articulate these expectations as conditions that recreational activities in protected areas must meet. Such activities are considered "conditionally compatible" with the protection of the covered species. However, the assumption of compatibility is flawed because: for example, designated trails and trail networks are often ecologically inappropriately planned, designed, or sited; and, even for authorized recreation, there is rarely adequate management to control the allowed types and levels of recreation such that they are compatible with conservation. While finding an appropriate balance between biodiversity conservation and recreation is complicated because recreation-related effects on wildlife vary among species and recreational activities (Larson et al. 2016), there are also societal factors at play that further complicate achieving an appropriate balance and compatibility.

Factors allowing inappropriate planning/siting and inadequate management - a societal conundrum.—The degree to which the above-listed expectations are met varies among NCCP/HCP permittees and other managers of dual-role protected areas, the primary limiting factors being fiscal constraints and each land manager's primary mission. As to the latter factor, for areas protected primarily or solely to conserve biological resources, a serious fundamental conflict with conservation arises when managers' primary mission is to provide recreational opportunities, and the protection of biological resources is a secondary or tertiary priority. As to fiscal constraints, land management budgets generally have not kept pace with the increasing levels of recreation in protected areas (CDFW 2015; Havlick et al. 2016). For example, the activities of the CDFW for resource assessment, conservation planning, and wildlife conservation at risk are "severely underfunded;" in 2005, maintenance, restoration, and management of CDFW's wildlife areas and ecological reserves were supported, on average, at the level of $13 per acre (0.40 ha) and one staff person per 10,000 acres. Many lands were operated at $1 per acre, with no dedicated staff (CDFW 2015—refer to Volume 1, Section 7.3). CDFW's fiscal shortfalls for managing its protected areas mirror the same among public agencies at the local, state, national, and international levels (CDFW 2015); these shortfalls result in continual grave shortages of management personnel and other resources.

California's State Wildlife Action Plan (CDFW 2015) and most of the literature about recreation-related ecological effects identify the economic, educational, and recreational/health benefits of protected areas. They also identify the benefits (e.g., economic) to protected areas from humans pursuing recreational activities. So, despite the documented recreation-related disturbance to wildlife, there seems to be an implicit assumption of a mutually beneficial relationship between protected areas and the humans who benefit from them. But,

the severe underfunding of management for protected areas renders mutual reciprocity in this relationship infeasible; the protected areas' wildlife are heavily on the losing side. This is particularly perplexing given the evidence that lack of adequate management negatively affects not only biological resources, but also societal benefits.

Regarding the human health benefits of protected areas, visible recreation-related damage to the terrain diminishes the level of benefit people enjoy while being in nature, as illustrated by a study examining the relationship between recreational impacts in protected areas and human mental/emotional states (Taff et al. 2019). The study's results demonstrate that, as visible recreation-related ecological impacts increased, sense of wellbeing and mental state decreased, especially in response to settings with unauthorized trails. Collectively, the results show that managing tourism in protected areas in a manner that reduces such impacts is essential to providing beneficial cultural ecosystem services related to human health and wellbeing (Taff et al. 2019). As Wolf et al. (2019) put it, the more attractive a site is, the more likely it is that it will be degraded, which in turn, may diminish the quality of the human experience, and thus, visitor satisfaction. To capitalize fully on the positive aspects of tourism (including recreation) for protected areas, the degradation of resources needs to be constrained to ecologically acceptable levels, and to levels beyond visitor perception (Davies and Newsome 2009; Wolf et al. 2019); otherwise, recreationists may think it unimportant to minimize their own impacts. Also diminishing the human experience are the closures to public access as a default reaction to lack of adequate management, and the liability resulting from injuries that can occur when people use unauthorized trails (Dertien et al. 2018).

There is a two-fold irony here: despite the prevalent emphasis on the societal benefits of protected areas and the purported reciprocal relationship between protected areas and humans, most agencies responsible for managing protected areas are chronically underfunded. And, promoting the pursuit of these societal benefits without protecting the dual-role protected areas' core function (biological conservation) from that pursuit actually undermines both the human experience and biological conservation. This is a societal conundrum that stems at least in part from a societal disconnection.

The factor of a societal disconnection.—A lack of public interest in and concern about protected areas figures into the societal conundrum. Public opposition to trail closures, caps on daily visitation, or reservation systems can be strong and could damage the support for conservation agencies and organizations (Reed et al. 2019), despite the ecological need for such measures for protected areas. A disconnection pervades our society with respect to recreation-related disturbance to wildlife (Marzano and Dandy 2012): 50% of 640 backcountry trail users surveyed in 2001 did not believe that recreation negatively affects wildlife, and recreationists generally held members of other user groups responsible for stress or negative effects on wildlife rather than holding members of their own recreational user group responsible (Taylor and Knight 2003). The results of a survey conducted in 2018 for the San Diego End Extinction (SDEE) initiative to elucidate what the San Diego public know, think, feel, and do in relation to species and habitat conservation, indicate that 71% of the 600 respondents are not knowledgeable about the problems San Diego's plants and wildlife face (Tinkler et al. 2019).[13] While the passage of California Proposition 68 in 2018 reflects the voters' broad support for clean water and access to open space, which were the main elements of the Proposition that promotional efforts emphasized, it is unclear how

[13] The respondents were San Diego County voters and were representative of the voter pool in terms of age, gender, ethnicity, and region, but voters tend to be less ethnically diverse and more educated than the San Diego County population overall (Tinkler et al. 2019).

much the biological conservation-related elements of the Proposition influenced voters.

Overall, it is probable that a large majority of the general public are unaware of or in denial about the disturbance to wildlife from non-consumptive recreation, much less the distinctions between areas protected primarily or solely for conservation and areas otherwise designated as open space (e.g., recreational fields, golf courses, small community parks). Information on these topics is not widely available, and what is in the literature, may not be reaching a broad audience even among conservation scientists and wildlife ecologists (Larson et al. 2016). What then can be done to address this unawareness as a step toward enabling dual-role protected areas to meet their conservation objectives despite the expanding recreational pressure?

Suggested plan of action.—To enable dual-role protected areas to meet their conservation objectives despite the expanding recreational pressure, the optimal approach is to: ensure that all recreational areas (e.g., trails and trail networks) are planned, designed, and sited using ecologically sound criteria; and, to continually employ sufficient proactive and adaptive management to prevent or at least minimize recreation-related disturbance to wildlife; such management would curtail the need for regular enforcement. This approach also has the potential to yield general public support for management, particularly if information provided about management challenges includes data and supporting graphics, specifically about fragmentation, to enhance the public's understanding of the challenges of poorly designed trail systems and the creation and use of unauthorized trails (Leung et al. 2011; Taff et al. 2019; Wolf et al. 2019). But this approach requires perpetual personnel and funding explicitly for management, which in turn points to the urgent need for public advocacy to secure fiscal support for management resources (i.e., fiscal support that is sustainable, perpetual, and at levels commensurate with the recreational pressure; footnote #5). How can this be achieved?

How people perceive their and others' recreation-related effects on wildlife may influence their general perspectives on such effects (Marzano and Dandy 2012). Shifting this perception-perspective nexus over time toward a common value of respecting wildlife may eventually mend some of the aforementioned societal disconnection. A shift in perspectives on the purpose of protected areas is also needed to one of understanding and acknowledging that their core function is conservation (Davies and Newsome 2009; Patten et al. 2017). The only chance there is of influencing people's perceptions is making the pertinent scientific information readily available. So, it is essential to implement a concerted campaign to disseminate science-based information about recreation-related disturbance to wildlife. Such a campaign needs to be well orchestrated, widespread, long-term, continual, and multimedia; this includes social media per Greer at al.'s (2017) conclusions about its efficacy in this context. In addition to the general public/voters (including recreationists), the following parties would be both the audience and the distributors within each of their fields and beyond: the media, environmental organizations, elected officials, policy and land-use decision makers, land management agencies and organizations, outdoor recreation merchants and associations, educational institutions, and researchers. The coverage would be framed as stories aimed to evoke appreciation for the diversity of sensitive species and the many ways they respond to our presence, and provide opportunities for what people can do to lessen the recreation-related disturbance to wildlife, which will benefit not only wildlife and other biological resources in the protected areas, but also the human experience there.

While the objectives of the campaign would be to influence people's perspectives in favor of wildlife and to modify recreational behaviors, policy, planning, and decision-

making accordingly, the final goal would be to cultivate support for and harness the power of advocacy to gain the political will and action needed to secure perpetual fiscal support for management resources. Implementing such a campaign would not be easy nor fast and would take diligent oversight, as suggested by William Craven, the chief consultant for nearly 20 years of California's Senate Natural Resources and Water Committee. In an interview with the California Native Plant Society, he stated, "the best way to achieve your policy objectives is to make sure your policy objectives are funded. For example, small but important programs for the [California Department of Fish and Wildlife] are literally budget dust in the California budget, but unless someone is there to pay attention and connect the dots between the budget and the state laws, we don't get a complete resolution…[P]ositive changes in state law that everyone works so hard to accomplish are really much more effective when someone monitors the budget process to make sure those changes get as much funding as possible" (CNPS 2020). But, it seems that the choices are either to never reverse or at least halt the downward trajectory of wildlife in protected areas experiencing damaging levels and types of recreation or to ambitiously implement such a campaign toward a societal course change (Waterman 2019 for the term "course change").

Several of the results of the survey conducted for the SDEE initiative hint at a potential to mobilize a critical mass of people who learn about the recreation-related disturbance to wildlife and the associated urgent need for resources to address it, and assist in information dissemination. While the survey conducted for the SDEE initiative revealed a knowledge deficit among the respondents regarding problems plants and wildlife face, its results also indicate that, over a 12-month period, 74% of respondents voted in favor of laws to protect the environment, 31% volunteered to improve the environment, and 21% donated money to protect San Diego County's environment; in addition, approximately 70% were willing to pay additional local taxes to protect the environment, and a majority of the respondents were willing to pay up to $50 per year (Tinkler et al. 2019).

One avenue available for advocacy to secure perpetual fiscal support specifically for management of protected areas is assessing recreational fees and taxes. With respect specifically to the management of CDFW-owned protected areas, CDFW's 2005 and 2015 State Wildlife Action Plans recommended implementation of recreational fees and taxes beyond fishing and hunting licenses that would allow non-consumptive recreationists to support wildlife conservation and management of the resources they use and enjoy (CDFW 2015, 2016). To generate funds for the management of all protected areas, a long-successful model could be employed: since the 1930s, hunters have been paying federal excise taxes on the sales of sport hunting and shooting equipment to generate funding for habitat conservation (CDFW 2015). Eighty years later, these taxes plus sales of angling equipment had generated more than $10 billion towards conservation (CDFW 2015). Thus, hunters and anglers have been the primary funding sources for conservation efforts in California and North America (CDFW 2015). Considering the disturbance to wildlife from non-consumptive recreationists, it is past time for them also to pay their way for the use of protected areas through paying taxes on equipment for hiking, biking, riding, etc. to support management of these activities. A secondary benefit of such fees and taxes is that they may establish a direct connection for recreationists between their use of protected areas and the costs of protecting the protected areas, and thereby possibly diminish their disconnection from their disturbance to wildlife.

Other avenues for advocacy to secure fiscal support for management of protected areas include bond measures and voluntary contribution funds (VCF), though neither would necessarily provide a reliably perpetual source of funding. VCFs are sponsored by legislators

to be enacted by the legislature; a VCF in this context would be explicitly and solely for the management of the protected areas in California, including CDFW's lands (with protected areas and management defined as described in footnotes #1 and #5, respectively). The funds must be administered such that they are made available timely. This would be similar to the VCF for California's Rare and Endangered Species Preservation Voluntary Tax Contribution Program which has funded work benefiting California's native at-risk plants, wildlife, and fish since 1983 (CDFW 2019) and now raises around $500,000 annually (FTB 2019).

Mainstream online and print media carried several articles in 2018 and 2019 about the overcrowding at and underfunding for the national parks (e.g., Simmonds et al. 2018; Waterman 2019; Wilson 2019); coverage such as this provides a good foundation of information. Articles like Yong's (2019) about the effects of the human voice alone on wildlife and Peterson's (2019) about the effects of hiking on elk represent steps in the right direction toward mainstream media honing in on specific impacts on wildlife from recreationists in protected areas. Coverage on species local to where people live is important and may make a stronger and more lasting impression with greater potential for shifting the perception-perspective nexus than species or settings remote from consumers of the media. Organizations like San Diego Zoo Global, which spearheaded the SDEE initiative (Tinkler et al. 2019), could significantly assist the campaign by engaging their media engines on behalf of local wildlife threatened by recreation.

A societal quid pro quo for protected areas?—At some point, the exploitation of protected areas resulting from recreation-related disturbance to wildlife, without commensurate reciprocity with care for the protected areas, may outweigh the benefits of public access to protected areas (Bennett et al. 2013). Many protected areas have already reached this point. Without adequate resources to combat the challenge of the obligation to conserve wildlife exposed to ecologically damaging levels and types of recreation, including unauthorized activities, the challenge will persist indefinitely at great risk of jeopardizing the protected areas' ability to meet their conservation objectives.

Regarding the pressure local, state, and federal government agencies have undergone for decades to acquire additional open space for recreation and to expand public access in existing protected areas (Wells 2000 in Reed and Merenlender 2008), elected officials and land-use decision makers need to address the demands, but not at the expense of biological conservation in protected areas. Some of the protected areas (e.g., the NCCP/HCP reserves) represent long-negotiated compromises for the sensitive species they are intended to protect in perpetuity. For some protected areas, no ecologically sound further compromise (e.g., expansion of public access) is possible; while recreation may be considered conditionally compatible in such protected areas, if open to public access at all, the extant levels of recreation may strain their ability to meet their conservation objectives. Protected areas that represent the final compromise for the species they support are particularly vulnerable to their wildlife values being compromised due to inadequate management (CDFW 2015). Ultimately, for wildlife that avoids human activity, it is unlikely that dual-role protected areas are entirely sufficient or justifiable for meeting conservation objectives; limiting or prohibiting recreation in strategic circumstances and locations within protected areas is necessary to achieve conservation objectives (Reed and Merenlender 2008; Bötsch et al. 2018; Dertien et al. 2018; Reed et al. 2019). Of course, this presumes sufficient management to maintain whatever recreational limits are set.

In summary, in the interest of wildlife in California and, more broadly, conservation within protected areas everywhere, the necessary actions with respect to non-consumptive

recreation are to: (1) widely and continually disseminate science-based information about the recreation-related disturbance to wildlife; (2) apply the science to all planning for, policy- and decision-making about, and management of, recreation in dual-role protected areas; and (3) secure perpetual fiscal support for management of recreation in dual-role protected areas commensurate with the recreational pressure.

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LITERATURE CITED

Amo, L., P. López, and J. Martín, J. 2006. Nature-based tourism as a form of predation risk affects body condition and health state of *Podarcis muralis* lizards. Biological Conservation 131:402–409.

Baker A. D., and P. L. Leberg. 2018. Impacts of human recreation on carnivores in protected areas. PLoS ONE 13(4):e0195436.

Baker, D. J., S. T. Garnett, J. O'Connor, G. Ehmke, R. H. Clarke, J. C. G. Woinarski, and M. A. McGeoch. 2018. Conserving the abundance of nonthreatened species. Conservation Biology 33:319–328.

Ballantyne, M., O. Gudes, and C. M. Pickering. 2014. Recreational trails are an important cause of fragmentation in endangered urban forests: a case study from Australia. Landscape and Urban Planning 130:112–124.

Beale, C. M., and P. Monaghan. 2004. Behavioural responses to human disturbance: a matter of choice? Animal Behaviour 68:1065–1069.

Bennett V. J., V. S. Quinn, and P. A. Zollner. 2013. Exploring the implications of recreational disturbance on an endangered butterfly using a novel modelling approach. Biodiversity and Conservation 22:1783–1798.

Bernard, G. E., W. F. D. van Dongen, P. G. Guay, M. R. E. Symonds, R. W. Robinson, and M. A. Weston. 2018. Bicycles evoke longer flight-initiation distances and higher intensity escape behaviour of some birds in parks compared with pedestrians. Landscape and Urban Planning 178:276–280.

Blair, R. B., and A. E. Launer. 1997. Butterfly diversity and human land use: species assemblages along an urban gradient. Biological Conservation 80:113–125.

Bötsch, Y., Z. Tablado, D. Sheri, M. Kéry, R. F. Graf, and L. Jenni. 2018. Effect of recreational trails on forest birds: human presence matters. Frontiers in Ecology and Evolution 6(175).

Burger, J. C. 2012. An efficient monitoring framework and methodologies for adaptively managing human access on NCCP lands and other reserves in southern California. Final report to California Department of Fish and Wildlife for LAG #PO982014.

Cheptou, P. O., A. L. Hargreaves, D. Bonte, and H. Jacquemyn. 2017. Adaptation to fragmentation: evolutionary dynamics driven by human influences. Philosophical Transactions of the Royal Society B 372:20160037.

California Department of Fish and Wildlife (CDFW). 2014. Incorporation of Adaptive Management into Conservation Planning and Resource Management. Available from: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=86989&inline (September 2019).

California Department of Fish and Wildlife (CDFW). 2015. California State Wildlife Action Plan, 2015 Update: A Conservation Legacy for Californians. Edited by Armand G. Gonzales and Junko Hoshi, PhD. Prepared with assistance from Ascent Environmental, Inc., Sacramento, CA, USA.

California Department of Fish and Wildlife (CDFW). 2016. SWAP's Consumption and Recreational Uses and Companion Plan.

California Department of Fish and Wildlife (CDFW). 2019. CDFW News. Available from: https://cdfgnews.wordpress.com/tag/rare-and-endangered-species-preservation/ (March 2019).

California Native Plant Society (CNPS). 2020. Flora 3(2):13–16.

City of San Diego. 2019. Natural Resources Management Plan for Mission Trails Regional Park, San Diego, California. Prepared by RECON Environmental, Inc., San Diego, CA, USA.

Czech, B., P. R. Krausman, and P. K. Devers. 2000. Economic associations among causes of species endangerment in the United States: associations among causes of species endangerment in the United States reflect the integration of economic sectors, supporting the theory and evidence that economic growth proceeds at the competitive exclusion of nonhuman species in the aggregate. BioScience 50:593–601.

Davies, C., and D. Newsome. 2009. Mountain bike activity in natural areas: impacts, assessment and implications for Management—a case study from John Forrest National Park, Western Australia. CRC for Sustainable Tourism Pty, Australia.

Davis, C. A., D. M. Leslie, Jr., W. D. Walter, and A. Graber. 2010. Mountain biking trail use affects reproductive success of nesting golden-cheeked warblers. Wilson Journal of Ornithology 122(3):465–474.

Dertien, J. S., C. L. Larson, and S. E. Reed. 2018. Adaptive management strategy for science-based stewardship of recreation to maintain wildlife habitat connectivity. Wildlife Conservation Society, Americas Program, Bronx, NY, USA.

Franchise Tax Board (FTB). 2019. Available from: https://www.ftb.ca.gov/file/personal/voluntary-contribution-funds/annual-contribution/rare-and-endangered-species-preservation.html (June 2019).

George, S. L., and K. R. Crooks. 2006. Recreation and large mammal activity in an urban nature reserve. Biological Conservation 133:107–117.

Gill, J., K. Norris, and W. Sutherland. 2001. Why behavioral responses may not reflect the population consequences of human disturbance. Biological Conservation 97:265–268.

Greer, K., K. Day, and S. McCutcheon. 2017. Efficacy and perception of trail use enforcement in an urban natural reserve in San Diego, California. Journal of Outdoor Recreation and Tourism 18:56–64.

González, L. M., B. E. Arroyo, A. Margalida, R. Sánchez, and J. Oria. 2006. Effect of human activities on the behaviour of breeding Spanish imperial eagles (*Aquila adalberti*): management implications for the conservation of a threatened species. Animal Conservation 9:85–93.

Gutzwiller, K. J., A. L. D'Antonio, and C. A. Monz. 2017. Wildland recreation disturbance:

broad-scale spatial analysis and management. Frontiers in Ecology and the Environment 15(9).

Havlick, D. G., E. Billmeyer, T. Huber, B. Vogt, and K. Rodman. 2016. Informal trail creation: hiking, trail running, and mountain bicycling in shortgrass prairie. Journal of Sustainable Tourism.

Hennings, L. 2016. The impacts of dogs on wildlife and water quality: a literature review. Metro Parks and Nature, Portland, OR, USA. Included in Hennings 2017 as Appendix 1.

Hennings, L. 2017. Hiking, mountain biking and equestrian use in natural areas: a recreation ecology literature review. Metro Parks and Nature, Portland, OR, USA.

Kriebel, D., J. Tickner, P. Epstein, J. Lemons, R. Levins, E. L. Loechler, M. Quinn, R. Rudel, T. Schettler, and M. Stoto. 2001. The precautionary principle in environmental science. Environmental Health Perspectives 109:871–876

Larson, C. L., S. E. Reed, A. M. Merenlender, and K. R. Crooks. 2016. Effects of recreation on animals revealed as widespread through a global systematic review. PLoS ONE 11(12):e0167259.

Leung, Y. F., T. Newburger, M. Jones, B. Kuhn, and B. Woiderski. 2011. Developing a monitoring protocol for visitor-created informal trails in Yosemite National Park, USA. Environmental Management 47:93–106.

Marcot, B. G., and C. H. Flather. 2007. Species-level strategies for conserving rare or little-known species. Pages 125–164 in M. G. Raphael and R. Molina, editors. Conservation of Rare or Little-known Species. Island Press, Washington, D.C., USA.

Markovchick-Nicholls, L., H. M. Regan, D. H. Deutschman, A. Widyanata, B. Martin, L. Noreke, and T. A. Hunt. 2008. Relationships between human disturbance and wildlife land use in urban habitat fragments. Conservation Biology 22:99–109.

Marzano, M., and N. Dandy. 2012. Recreationist behaviour in forests and the disturbance to wildlife. Biodiversity and Conservation 21:2967–2986.

Moore, M. J. C., and R. A. Seigel. 2006. No place to nest or bask: effects of human disturbance on the nesting and basking habits of yellow-blotched map turtles (Graptemys flavimaculata). Biological Conservation 130:386–393.

Naylor, L. M., M. J. Wisdom, and R. G. Anthony. 2009. Behavioral responses of North American elk to recreational activity. Journal of Wildlife Management 73:328–338.

Patten, M., and J. Burger. 2018. Reserves as double-edged sword: avoidance behavior in an urban-adjacent wildland. Biological Conservation 18:233–239.

Patten, M., J. Burger, and M. Mitrovich. 2017. Assessing Effectiveness of Adaptive Recreation Management Strategies and Evaluation of Core NCCP/HCP Habitat Areas. Final Report for California Department of Fish and Wildlife Local Assistance Grant #P1482109.

Pauli, B. P., R. J. Spaul, and J. A. Heath. 2017. Forecasting disturbance effects on wildlife: tolerance does not mitigate effects of increased recreation on wildlands. Animal Conservation 20:251–260.

Peterson, C. 2019. Americans' love of hiking has driven elk to the brink, scientists say. The Guardian. August 25. Available from: https://www.theguardian.com/environment/2019/aug/25/hiking-elk-driven-to-brink-colorado-vail.

Pickering, C. M. 2010. Ten factors that affect severity of environmental impacts of visitors

to protected areas. Ambio 39(1):70–77
Reed, S. E., and A. M. Merenlender. 2008. Quiet, nonconsumptive recreation reduces protected area effectiveness. Conservation Letters 1:146–154.
Reed, S. E., C. L. Larson, K. R. Crooks, A. M. Merenlender. 2014. Wildlife Response to Human Recreation on NCCP Reserves in San Diego County. Wildlife Conservation Society Agreement No/LAG #: P1182112.
Reed, S. E., C. L. Larson, and K. R. Crooks. 2019. Effects of Human Use of NCCP Reserves on Reptile and Mammal Species in San Diego**.** Wildlife Conservation Society Agreement No/LAG #: P1582100.
Reilly, M. L., M. W. Tobler, D. L. Sonderegger, and P. Beier. 2017. Spatial and temporal response of wildlife to recreational activities in the San Francisco Bay ecoregion. Biological Conservation 207:117–126.
Rodríguez-Prieto I., and E. Fernández-Juricic. 2005. Effects of direct human disturbance on the endemic Iberian frog *Rana iberica* at individual and population levels. Biological Conservation 123:1–9.
Säterberg, T., S. Sellman, and B. Ebenman. 2013. High frequency of functional extinctions in ecological networks. Nature 499:468–470.
Shively, K. J., A. W. Alldredge, and G. E. Phillips. 2005. Elk reproductive response to removal of calving season disturbance by humans. Journal of Wildlife Management 69:1073–1080.
Simmonds, C., A. McGivney, P. Reilly, B. Maffly, T. Wilkinson, G. Canon, M. Wright, and M. Whaley. 2018. Crisis in our national parks: how tourists are loving nature to death. The Guardian. November 18. Available from: https://www.theguardian.com/environment/2018 /nov/20/national-parks-america-overcrowding-crisis-tourism-visitation-solutions.
Soulé, M. E., and R. F. Noss. 1998. Rewilding and biodiversity: complimentary goals of continental conservation. Wild Earth 8(3):19–28.
Spahr, R. 1990. Factors affecting the distribution of bald eagles and effects of human activity on bald eagles wintering along the Boise River. Thesis, Boise State University, ID, USA.
Spaul, R. J., and Heath, J. A. 2016. Non-motorized and motorized recreation in shrubsteppe habitats affects the breeding behavior and reproductive outcome of a protected species. Ecology and Evolution 6:8037–8049.
Steven, R., C. Pickering, and J. G. Castley. 2011. A review of the impacts of nature-based recreation on birds. Journal of Environmental Management 92:2287–2294.
Suraci, J. P., M. Clinchy, L. Y. Zanette, and C. W. Wilmers. 2019. Fear of humans as apex predators has landscape-scale impacts from mountain lions to mice. Ecology Letters 22:1578–1586.
Taff, B. D., J. Benfield, Z. D. Miller, A. D'Antonio, and F. Schwartz. 2019. The role of tourism impacts on cultural ecosystem services. Environments 6:43.
Taylor, A. R., and R. L. Knight. 2003. Wildlife responses to recreation and associated visitor perceptions. Ecological Applications 13:951–963.
Tinkler, T., M. Ahearne, and M. J. Schumann. 2019. Collaborative species and habitat conservation efforts in San Diego County: a systematic needs assessment to guide the San Diego End Extinction Initiative. Environment 1.
Waterman, J. 2019. Our national parks are in trouble: blame overcrowding, invasive spe-

cies, climate change and money woes. The New York Times. November 22. Available from: https://www.nytimes.com/2019/11/22/opinion/sunday/national-parks-crowding-climate.html.

Wilcove, D. S., C. H. McLellan, and A. P. Dobson. 1986. Habitat fragmentation in the temperate zone. Pages 237–256 in M. E. Soulé, editor. Conservation Biology: the Science of Scarcity and Diversity. Sinauer Associates, Inc. Sunderland, MA, USA.

Wilson, M. 2019. What do we owe our national parks? The Atlantic. July 4. Available from: https://www.theatlantic.com/letters/archive/2019/07/national-park-maintenance-problems-arent-new/593293/.

Wolf, I. D., D. B. Croft, and R. J. Green. 2019. Nature conservation and nature-based tourism: a paradox? Environments 6:104.

Yong, E. 2019. The disturbing sound of a human voice. The Atlantic. July 17.

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Increased hiking and mountain biking are associated with declines in urban mammal activity

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Outdoor recreation can have negative consequences for many wildlife species (Larson et al. 2019, 2016; Monz et al. 2013; Sato et al. 2013). Increasingly, parks and preserves are embedded in a landscape of urban and suburban development (Radeloff et al. 2010), intensifying the exposure of remaining wildlife populations to human activity (Larson et al. 2018). In California, several research groups have studied wildlife responses to recreation in parks and preserves within densely populated coastal cities. Some of the resulting studies have documented negative effects, including declines in native mammal occupancy and detection rates (Patten and Burger 2018; Reed and Merenlender 2008) and reduced daytime activity (George and Crooks 2006), while others have found limited effects of recreation on wildlife occupancy and detection rates (Markovchick-Nicholls et al. 2008; Reilly et al. 2017). Managers need context-specific understanding of the nature and severity of recreation effects on wildlife to sustainably manage recreational use in protected areas, the vast majority of which are open to the public (Leung et al. 2018; UNEP-WCMC and IUCN 2019).

Experimental tests of recreation effects on wildlife can provide valuable insight into species' responses to human activity by minimizing variation in other factors that affect wildlife, such as residential development and vegetation composition. However, fewer than one-third of studies of recreation effects on wildlife include an experimental component (Larson et al. 2016), and a large proportion of experimental treatments exclusively measure immediate reactions of wildlife to an approaching human, often using flight initiation distance (e.g., Ikuta and Blumstein 2003; Jorgensen et al. 2016; Keeley and Bechard 2011). These immediate responses cause increased energy expenditure and can trigger trade-offs between

foraging and flight behaviors (Duchesne et al. 2000), but it is less clear how they may translate into longer-term habitat degradation due to the regular presence of recreationists. It can be logistically difficult to experimentally alter the level of recreation on a trail segment or within a defined area, but when successfully implemented such studies have documented increased presence of nest predators (Gutzwiller et al. 2002) and reduced numbers of bird territories and bird species richness (Bötsch et al. 2017).

Conservation of mammals in densely populated and fragmented habitats such as southern California requires an understanding of the suitability of remaining habitat patches (Crooks 2002; Ordeñana et al. 2010), many of which receive high levels of recreational use (Larson et al. 2018). In this study, we assessed whether increased recreation rates were associated with reduced habitat suitability for native mammals. We conducted an opportunistic, quasi-experimental study of recreation effects on mammals using a before-after-control-impact (BACI) design, taking advantage of the closure and re-opening of an existing recreational trail in an open space park in San Diego, California. We expected that at impact locations (sampling points on the trail that was closed and re-opened), hiking and mountain biking would increase and wildlife activity would decline after the trail re-opened, while human and wildlife activity would remain similar at control locations (sampling points on trails consistently open throughout the study) within the same reserve.

The study was conducted in Black Mountain Open Space Park (32.984, -117.117) in San Diego, California, USA, which is owned and managed by the City of San Diego. The park is 951 ha, comprised primarily of coastal sage scrub and chaparral vegetation communities with some riparian and native and non-native grassland habitats. Dense suburban communities surround the park, and it contains approximately 32 kilometers of multi-use trails visited primarily by hikers and mountain bikers. The park also permits leashed dogs on the trails.

We established a total of seven sampling points on official and unofficial trails within the park in January 2017. Two points were located along the Miner's Ridge loop trail ("impact points", Figure 1), which was closed to public access from January 2017 until April 2018 for testing and remediation of elevated levels of arsenic detected in the soil. Five points were located along nearby trails not affected by the closure ("control points"; Figure 1). Point locations were selected as part of a larger project using a spatially balanced random design using the RRQRR algorithm on rasterized trail network data (Theobald et al. 2007).

To monitor human and mammal activity, we installed one motion-triggered camera (Bushnell TrophyCam HD Aggressor) at each sampling point, housed in metal security boxes and affixed to metal poles pounded into the soil facing recreational trails. We did not bait the cameras to avoid influencing animal activity (Wearn and Glover-Kapfer 2019). Cameras were programmed to take two photos per trigger with a five second delay between triggers. We began monitoring human and mammal activity at the impact points in late October 2017, leaving cameras running continuously until after the trail re-opened in April 2018. At the control points, we collected data between November 2017 and February 2018. After the trail re-opened, cameras operated at all seven sampling points for at least four weeks, ending in June 2018 (Table 1).

The seven cameras captured over 80,000 photos during the study period. Many of these were "false triggers" caused by rapidly growing vegetation, high temperatures, and wind, mostly in the mid-morning to late afternoon. Therefore, we randomly subsampled 20% of photos between 11 am and 5 pm at all sampling points to reduce time spent sorting

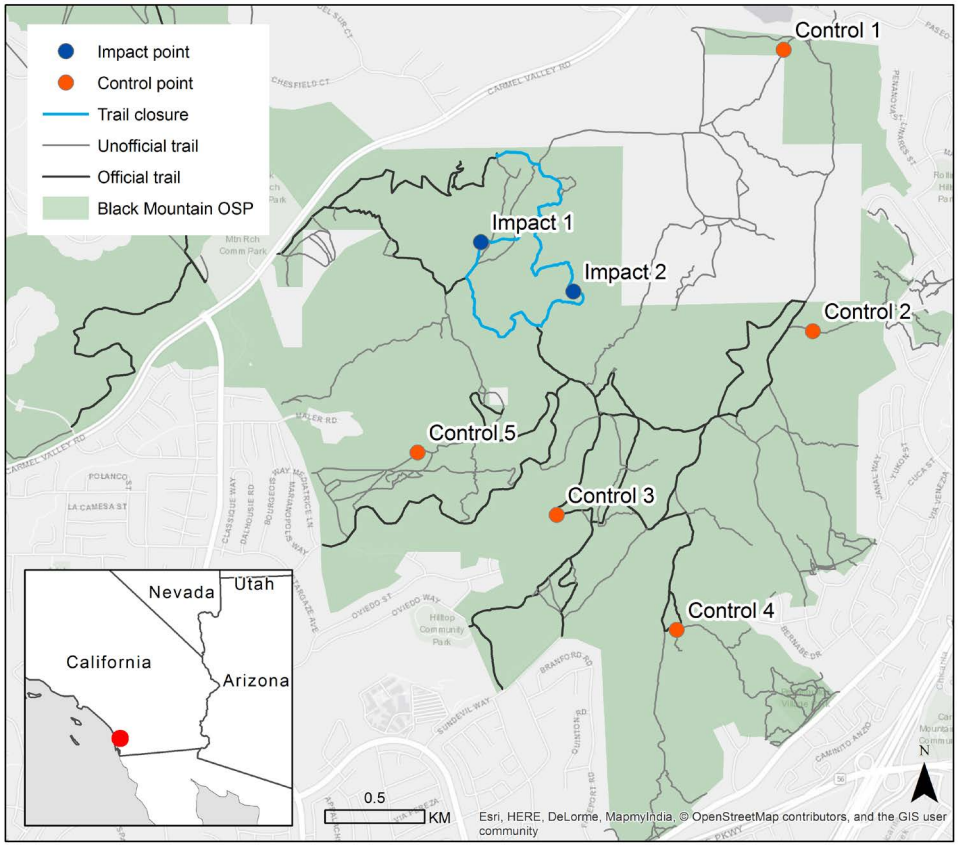

Figure 1. Location and **s**ampling design of the before-after-control-impact (BACI) study conducted in Black Mountain Open Space Park in San Diego, CA, USA.

Table 1. Dates of camera data collection before and after the trail re-opened at impact and control sampling points at Black Mountain Open Space Park. Cameras were not installed or did not operate correctly on all days between the first and last sampling day; the "total days" columns report the number of days on which cameras were operational.

	Sampling effort before trail re-opened			Sampling effort after trail re-opened		
Point	First day	Last day	Total days	First day	Last day	Total days
Impact 1	1 Nov 2017	17 Apr 2018	134	19 Apr 2018	31 May 2018	43
Impact 2	1 Nov 2017	17 Apr 2018	168	19 Apr 2018	28 Apr 2018	27
Control 1	12 Dec 2017	1 Feb 2018	26	18 May 2018	30 May 2018	13
Control 2	12 Dec 2017	1 Feb 2018	26	4 May 2018	31 May 2018	28
Control 3	18 Nov 2017	13 Dec 2017	5	4 May 2018	30 May 2018	22
Control 4	18 Nov 2017	22 Dec 2017	26	4 May 2018	30 May 2018	28
Control 5	19 Nov 2017	22 Dec 2017	21	4 May 2018	31 May 2018	29

photos. Photos were organized in the Colorado Parks & Wildlife Photo Warehouse (Ivan and Newkirk 2016). Humans appearing in photos were categorized by activity (pedestrian, cyclist, equestrian, or vehicle) and animals were identified to species, except for brush rabbit (*Sylvilagus bachmani*) and desert cottontail (*S. audubonii*), which are difficult to distinguish in photos and were both labeled "rabbit."

To assess changes in human activity before and after the trail re-opened, we compared mean people per day at impact and control points using a non-parametric Wilcoxon-Mann-Whitney test since the data are counts. To assess changes in mammal habitat use before and after the trail re-opened, we used single-species occupancy models for each mammal species with sufficient detections using the R package *unmarked* (Fiske and Chandler 2011). Detection data were pooled into 5-day sampling occasions, resulting in ten survey occasions with five before and five after the trail re-opening. We did not include habitat covariates because minimal changes in habitat occurred between the sampling periods and because our primary goal was to investigate the interaction of treatment (control or impact sampling point) and time period (before or after the trail re-opened). Therefore, treatment and time period were the only variables included in the models, and we included the interaction (treatment*period) to test whether species showed a response to the trail re-opening. When a species was predicted to occur at all or nearly all sampling points, we assessed changes in detection probability rather than occupancy as a measure of relative activity or frequency of habitat use (Lewis et al. 2015; Wang et al. 2015).

Across all sampling points and time periods, there were an average (± 1 SD) of 12.2 ± 21.7 hikers, 7.2 ± 10.0 cyclists, 1.7 ± 3.2 dogs, and 0.01 ± 0.2 horseback riders per day at each sampling point, as well as infrequent motorized vehicles (park staff or utility personnel) at one sampling point where the trail was drivable. These recreation rates are relatively low compared to other parks and preserves in the region (Larson et al. 2018). People did not cease using the trail while it was closed, with the two impact points averaging 18.0 ± 15.8 and 20.4 ± 14.9 people per day during the closure (Figure 2). However, human activity approximately doubled at the impact points after the trail re-opened, averaging 38.2 ± 28.9 and 38.9 ± 19.6 per day (time period differences: $P < 0.001$). At the control points, human activity was similar between time periods (all $P > 0.33$) except for Control 5, which averaged 5.7 ± 8.1 people per day before and 23.2 ± 13.0 after the trail re-opened ($P < 0.001$). Control 5, located on an unofficial trail, is not part of the most obvious loop routes that could be made using the closed trail, but it could be connected with a longer loop route using unofficial trails, and therefore may have experienced depressed visitation rates during the closure period. Therefore, we ran additional occupancy models in which Control 5 was considered an impact point to ensure our results were robust to this possibility.

Mammal species we detected included rabbits (*Sylvilagus spp.*, total photos n = 537), coyotes (*Canis latrans*, n = 409), bobcats (*Lynx rufus*, n = 135), California ground squirrels (*Otospermophilus beecheyi*, n = 22), black-tailed jackrabbits (*Lepus californicus*, n = 4), raccoons (*Procyon lotor*, n = 2), and mule deer (*Odocoileus hemionus*, n = 1). However, only the bobcat, coyote, and rabbit were detected frequently enough for analysis. Bobcats were detected at six out of seven sampling points, and coyotes and rabbits were detected at all seven points; accordingly, we used detection probability rather than occupancy as our primary variable measuring changes in frequency of habitat use for all three species. At sampling points where they were detected, each species was detected at least once before and after the trail re-opening.

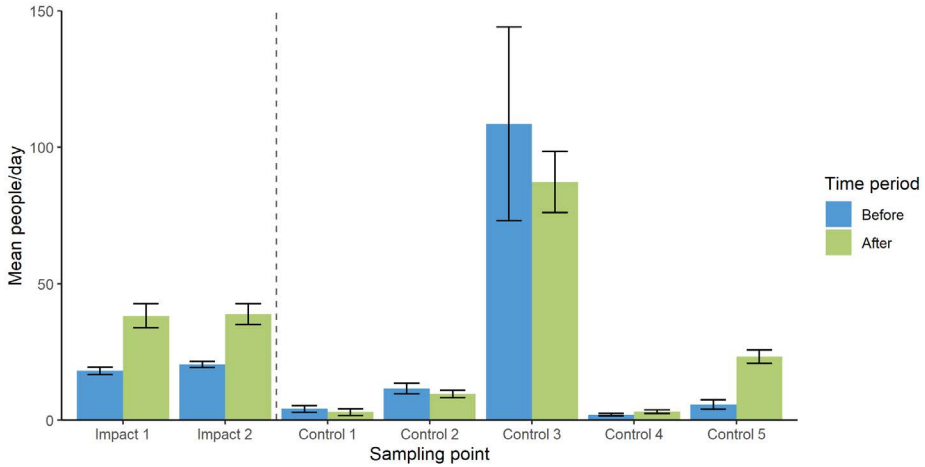

Figure 2. Human activity (mean people per day) before and after the Miners Ridge Loop trail re-opened at impact and control sampling points at Black Mountain Open Space Park. Error bars show one standard error. Differences between time periods were significant ($p < 0.05$ using a *t*-test) at Impact 1, Impact 2, and Control 5. The vertical dotted line divides the impact points (left) from the control points (right).

Occupancy models showed that detection probability was reduced at impact points after the trail re-opened for bobcats and coyotes, while remaining approximately the same at the control points (Figure 3). The effect was particularly strong for bobcats, with detection probability dropping from 0.90 ± 0.09 to 0.40 ± 0.15 at impact points after the trail re-opened while detection probability at control points increased slightly from 0.53 ± 0.13 to 0.65 ± 0.12. The interaction of treatment*period for bobcats was significant (z = 2.15, P = 0.03). Coyotes were detected at impact points during nearly every occasion before the trail re-opened (detection probability of 1.00 ± 0.001) but afterwards detection probability dropped to 0.70 ± 0.14, while detection probability increased slightly at control points from 0.79 ± 0.09 to 0.82 ± 0.08. However, the interaction term was not significant for coyotes (z = 0.14, P = 0.89). Rabbit detection probability did not differ significantly in relation to time period or treatment (interaction term z = 0.52, P = 0.61). Results did not change for bobcats or rabbits when Control 5 was considered an impact rather than a control point, but for coyotes patterns became less clear, with detection probability dropping more at control than impact points after the trail re-opened.

The number of sampling points was small due to the opportunistic nature of our study, limiting our ability to detect an effect of altered recreation rates on wildlife activity. Therefore, the fact that we still observed reduced activity rates by bobcats and, to a lesser extent, coyotes is particularly notable. Our findings echo those of previous studies in the region, which have found that these species and other mammals avoid human presence on short time scales (same-day occurrence; Patten and Burger 2018), and restrict their activity

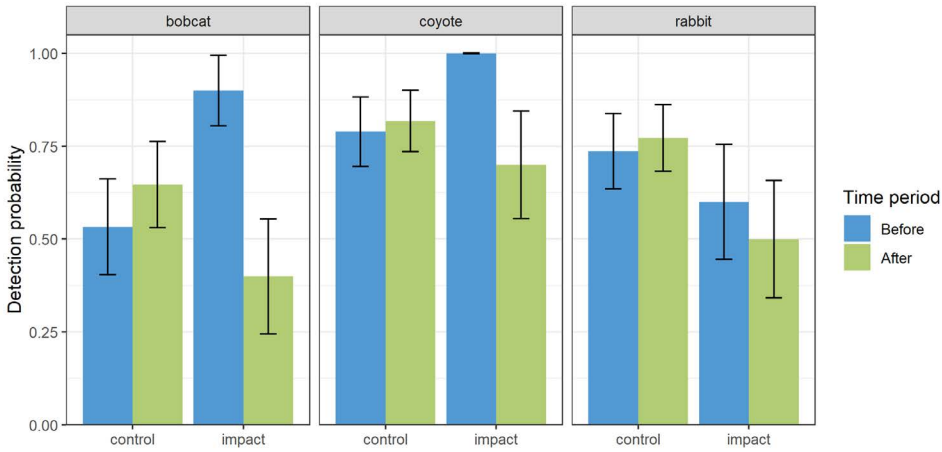

Figure 3. Predicted detection probabilities from single-species occupancy models for bobcats, coyotes, and rabbits before and after the Miners Ridge Loop trail re-opened at impact and control sampling points at Black Mountain Open Space Park. Error bars show one standard error. The interaction term for treatment*period was significant ($P < 0.05$) for bobcats.

in high human-use areas (George and Crooks 2006). We observed greater responsiveness in bobcats than in coyotes. While both carnivore species have shown sensitivity to recreation in previous studies (Patten and Burger, 2018; Reed and Merenlender 2008), coyotes can be relatively tolerant of human disturbance due to their adaptable behavior and omnivorous diet (Riley et al. 2003; Ordeñana et al. 2010). We did not observe changes in rabbit activity rates in connection with increased human activity, or by extension, reduced predator activity. Their smaller home ranges compared to bobcats and coyotes may mean that they are less able to shift their within-home range habitat use in response to short-term changes in human and predator activity.

Previous studies have also found that these species may shift their diel activity patterns to be more nocturnal in areas with higher human use (George and Crooks 2006; Reilly et al. 2017; Wang et al. 2015; Nickel et al. 2020). While shifts in diel activity patterns may have occurred in our system, overall activity levels were lower after the trail was re-opened, indicating than any temporal shift did not completely mitigate effects of human presence. However, despite changes in activity levels (as measured by detection probability), we did not observe changes in the occupancy status of the sampling points, suggesting that while the habitat may have been somewhat degraded, it was not completely unsuitable after the trail re-opened. Given the relatively small size of the park and its highly developed surroundings, reduced use of impact points by bobcats and coyotes likely indicates a partial shift in habitat use to other areas of the park. Bobcats slightly increased their use of the control points after the trail re-opened, perhaps suggesting such a shift, though this difference was negligible for coyotes.

Future experimental manipulations at larger spatial and temporal scales could help assess the consistency of our findings, increase the precision of estimated detection probability parameters, and assess responses of additional wildlife species. The opportunistic nature of our study design resulted in spatial separation of the impact and control points,

which may have limited their ability to serve as true replicates due to spatial autocorrelation (Legendre 1993). A true experimental design with randomly assigned treatment and control locations would provide stronger evidence of recreation effects, such as the study by Bötsch et al. (2017) which documented reductions in bird territory establishment in response to low levels of recreation compared to areas with no recreation. Coordination with volunteer groups and docent-led programs or using recorded human voices (e.g., Suraci et al. 2019; Ware et al. 2015) could make it more feasible to experimentally apply treatments that simulate higher levels of recreation.

Though the level of human activity approximately doubled after the trail was re-opened, we speculate that the difference may not have been obvious to recreationists. Forty people per day, approximately the average level of use after the trail re-opened, is still low compared to many other San Diego-area parks and preserves (Reed et al. 2019). However, this difference appears to have been perceptible and meaningful to wildlife, and perhaps crossed a critical threshold of disturbance causing reduced rates of use of the trail. Accordingly, habitat degradation near trails due to human disturbance is likely common across parks and preserves across the region.

Our findings highlight that wildlife can respond rapidly to changes in the levels of human disturbance, even when they have experienced similar levels of disturbance previously. Data collection for the 'after' period started immediately after the trail was re-opened and continued for four weeks. The observed reduction in detection probabilities suggests that bobcats, and to a lesser degree coyotes, may respond to changes in the relative intensity of human activity by rapidly altering their fine-scale habitat selection. Rapid avoidance responses to recreation have been previously documented for mountain caribou (Lesmerises et al. 2018) and bottlenose dolphins (Lusseau 2004), but it is not clear how short-term behavioral avoidance may translate to fitness or population impacts (Bejder et al. 2006). Higher recreation intensity was presumably not novel to these individuals since the trail had been open to recreation for many years prior to our study, which suggests that the animals were not fully tolerant of prior levels of human disturbance. It is therefore possible that for these species, habitat degradation from recreation could be relatively quickly reversed if human activity was limited to lower levels, or spatially or temporally constrained. Land and wildlife managers often use seasonal closures to protect wildlife during periods of heightened sensitivity such as the breeding period (Burger and Niles 2013; Coleman et al. 2013; Richardson and Miller 1997), but the efficacy of these closures is rarely tested. The rapid response we observed suggests that targeted temporal closures could be a promising approach for reducing impacts of recreation.

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Author contributions:
Conceived and designed the study: CLL, SER, KRC
Collected the data: CLL
Performed the analysis of the data: CLL
Authored the manuscript: CLL
Provided critical revision of the manuscript: CLL, SER, KRC

LITERATURE CITED

Bejder, L., A. Samuels, H. Whitehead, and N. Gales. 2006. Interpreting short-term behavioural responses to disturbance within a longitudinal perspective. Animal Behaviour 72:1149–1158.

Bötsch, Y., Z. Tablado, and L. Jenni. 2017. Experimental evidence of human recreational disturbance effects on bird-territory establishment. Proceedings of the Royal Society B 284:20170846.

Burger, J., and L. Niles. 2013. Shorebirds and stakeholders: Effects of beach closure and human activities on shorebirds at a New Jersey coastal beach. Urban Ecosystems 16:657–673.

Coleman, T. H., C. C. Schwartz, K. A. Gunther, and S. Creel. 2013. Grizzly bear and human interaction in Yellowstone National Park: An evaluation of bear management areas. Journal of Wildlife Management 77:1311–1320.

Crooks, K. R. 2002. Relative sensitivities of mammalian carnivores to habitat fragmentation. Conservation Biology 16:488–502.

Duchesne, M., S. D. Côté, and C. Barrette. 2000. Responses of woodland caribou to winter ecotourism in the Charlevoix Biosphere Reserve, Canada. Biological Conservation 96:311–317.

Fiske, I., and R. Chandler. 2011. unmarked: An R package for fitting hierarchical models of wildlife occurrence and abundance. Journal of Statistical Software 043.

George, S. L., and K. R. Crooks. 2006. Recreation and large mammal activity in an urban nature reserve. Biological Conservation 133:107–117.

Gutzwiller, K. J., S. K. Riffell, and S. H. Anderson. 2002. Repeated human intrusion and the potential for nest predation by gray jays. Journal of Wildlife Management 66:372–380.

Ikuta, L. A., and D. T. Blumstein. 2003. Do fences protect birds from human disturbance? Biological Conservation 112:447–452.

Ivan, J. S., and E. S. Newkirk. 2016. CPW Photo Warehouse: a custom database to facilitate archiving, identifying, summarizing and managing photo data collected from camera traps. Methods in Ecology and Evolution 7:499–504.

Jorgensen, J. G., L. R. Dinan, and M. Bomberger Brown. 2016. Flight initiation distances of nesting Piping Plovers (*Charadrius melodus*) in response to human disturbance. Avian Conservation and Ecology 11(1):5.

Keeley, W. H., and M. J. Bechard. 2011. Flushing distances of ferruginous hawks nesting in rural and exurban New Mexico. Journal of Wildlife Management 75:1034–1039.

Larson, C. L., S. E. Reed, A. M. Merenlender, and K. R. Crooks. 2019. A meta-analysis of recreation effects on vertebrate species richness and abundance. Conservation Science and Practice e93.

Larson, C. L., S. E. Reed, A. M. Merenlender, and K. R. Crooks. 2018. Accessibility drives species exposure to recreation in a fragmented urban reserve network. Landscape and Urban Planning 175:62–71.

Larson, C. L., S. E. Reed, A. M. Merenlender, and K. R. Crooks. 2016. Effects of recreation on animals revealed as widespread through a global systematic review. PLoS ONE 11(12):e0167259.

Legendre, P. 1993. Spatial autocorrelation: Trouble or new paradigm? Ecology 74:1659–1673.

Lesmerises, F., F. Déry, C. J. Johnson, and M.-H. St-Laurent. 2018. Spatiotemporal response of mountain caribou to the intensity of backcountry skiing. Biological Conservation 217:149–156.

Leung, Y.-F., A. Spenceley, G. Hvenegaard, and R. Buckley (editors). 2018. Tourism and visitor management in protected areas: guidelines for sustainability. IUCN, International Union for Conservation of Nature, Gland, Switzerland.

Lewis, J. S., K. A. Logan, M. W. Alldredge, L. L. Bailey, S. VandeWoude, and K. R. Crooks. 2015. The effects of urbanization on population density, occupancy, and detection probability of wild felids. Ecological Applications 25:1880–1895.

Lusseau, D. 2004. The hidden cost of tourism: detecting long-term effects of tourism using behavioral information. Ecology and Society 9(1):2.

Markovchick-Nicholls, L., H. M. Regan, D. H. Deutschman, A. Widyanata, B. Martin, L. Noreke, and T. A. Hunt. 2008. Relationships between human disturbance and wildlife land use in urban habitat fragments. Conservation Biology 22:99–109.

Monz, C. A., C. M. Pickering, and W. L. Hadwen. 2013. Recent advances in recreation ecology and the implications of different relationships between recreation use and ecological impacts. Frontiers in Ecology and the Environment 11:441–446.

Nickel, B. A., J. P. Suraci, M. L. Allen, and C. C. Wilmers. 2020. Human presence and human footprint have non-equivalent effects on wildlife spatiotemporal habitat use. Biological Conservation 241:108383.

Ordeñana, M. A., K. R. Crooks, E. E. Boydston, R. N. Fisher, L. M. Lyren, S. Siudyla, C. D. Haas, S. Harris, S. A. Hathaway, G. M. Turschak, A. K. Miles, and D. H. Van Vuren. 2010. Effects of urbanization on carnivore species distribution and richness. Journal of Mammalogy 91:1322–1331.

Patten, M. A., and J. C. Burger. 2018. Reserves as double-edged sword: Avoidance behavior in an urban-adjacent wildland. Biological Conservation 218:233–239.

Radeloff, V. C., S. I. Stewart, T. J. Hawbaker, U. Gimmi, A. M. Pidgeon, C. H. Flather, R. B. Hammer, and D. P. Helmers. 2010. Housing growth in and near United States protected areas limits their conservation value. Proceedings of the National Academy of Sciences 107:940–945.

Reed, S. E., C.L. Larson, and K. R. Crooks. 2019. Effects of Human Use of NCCP Reserves on Reptile and Mammal Species in San Diego. Wildlife Conservation Society, Americas Program, New York, NY, USA.

Reed, S. E., and A. M. Merenlender. 2008. Quiet, nonconsumptive recreation reduces protected area effectiveness. Conservation Letters 1:146–154.

Reilly, M. L., M. W. Tobler, D. L. Sonderegger, and P. Beier. 2017. Spatial and temporal response of wildlife to recreational activities in the San Francisco Bay ecoregion. Biological Conservation 207:117–126.

Riley, S. P. D., R. M. Sauvajot, T. K. Fuller, E. C. York, D. A. Kamradt, C. Bromley, and R. K. Wayne. 2003. Effects of urbanization and habitat fragmentation on bobcats and coyotes in southern California. Conservation Biology 17:566–576.

Richardson, C. T., and C. K. Miller. 1997. Recommendations for protecting raptors from human disturbance: a review. Wildlife Society Bulletin 25:634–638.

Sato, C. F., J. T. Wood, and D. B. Lindenmayer. 2013. The effects of winter recreation on alpine and subalpine fauna: a systematic review and meta-analysis. PLoS ONE 8(5):e64282.

Suraci, J. P., M. Clinchy, L. Y. Zanette, and C. C. Wilmers. 2019. Fear of humans as apex predators has landscape-scale impacts from mountain lions to mice. Ecology Letters 22:1578–1586.

Theobald, D. M., D. L. Stephens Jr., D. White, N. S. Urquhart, A. R. Olsen, and J. B. Norman. 2007. Using GIS to generate spatially balanced random survey designs for natural resource applications. Environmental Management 40:134–146.

UNEP-WCMC and IUCN. 2019. The World Database on Protected Areas (WDPA). UNEP-WCMC and IUCN, Cambridge, UK.

Wang, Y., M. L. Allen, and C. C. Wilmers. 2015. Mesopredator spatial and temporal responses to large predators and human development in the Santa Cruz Mountains of California. Biological Conservation 190:23–33.

Ware, H. E., C. J. W. McClure, J. D. Carlisle, and J. R. Barber. 2015. A phantom road experiment reveals traffic noise is an invisible source of habitat degradation. Proceedings of the National Academy of Sciences 112:12105–12109.

Wearn, O. R., and P. Glover-Kapfer. 2019. Snap happy: camera traps are an effective sampling tool when compared with alternative methods. Royal Society Open Science 6:181748.

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An assessment of non-consumptive recreation effects on wildlife: current and future research, management implications, and next steps

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Most research on the effects of non-consumptive recreation on wildlife to date has focused on birds and mammals. This research typically focuses on behavioral responses of individuals despite practical limitations in extrapolating ecological outcomes from individual behavior. Data gaps therefore present difficulties in integrating wildlife-protective policies into public access management. These gaps are exacerbated by a lack of wildlife studies that include data on public use patterns of open space areas. In a survey of park and open space managers in the San Francisco Bay Area, few of the entities surveyed restricted recreational access permanently or seasonally to address biological constraints; yet most indicated the presence of sensitive plant or animal species on their lands or stated conservation as one of their organization's purposes. To better bridge the gap between research and management practice, more research is needed on species beyond birds and mammals. This research should extend beyond noting behavioral response and should integrate investigation of outdoor recreation use patterns.

Key words: California, non-consumptive recreation, open space, parks, public access management, San Francisco Bay Area, wildlife

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Throughout the state of California, there exists a large diversity of designated open space and protected areas that allow public access and outdoor recreation. Based on data from the Survey of Public Opinions and Attitudes on Outdoor Recreation in California, the average number of days of outdoor recreation participation among adult Californians

is 96 days per year (California State Parks 2012). Based on California's population of approximately 27.4 million adults in 2008, California State Parks estimated approximately 2.6 billion days of outdoor recreation by adults during that year; that figure would be higher based on current population estimates. Within regional, state, or national parks, outdoor recreation participation (i.e., adults and children) totaled an estimated 478 million days, and for non-park natural and undeveloped areas there were an estimated 368 million annual days of outdoor recreation participation (California State Parks 2011).

A large portion of outdoor recreation activity consists of frequent use in the same areas by the same visitors. Much of it is relatively close to visitors' homes, and with California's warm, Mediterranean climate, outdoor recreation use often occurs near dawn and dusk, the times of day when multiple wildlife species are most active. Many areas where outdoor recreation occurs also provide occupied or potentially suitable habitat for special status wildlife species. California includes a variety of habitats that are occupied or potentially occupied by 181 state or federally listed wildlife species (CDFW 2019).

Non-consumptive forms of outdoor recreation (defined as those activities that do not include fishing and hunting) can impact wildlife species and their habitats in a variety of ways. There may be loss of individuals along trail corridors through incidental recreational use, such as crushing burrows or destroying nests. Non-consumptive recreation may also affect habitat. For example, recreation facility development can remove habitat, and recreational use of facilities can result in water quality degradation, soil erosion, and ground cover loss (USDA 2008). Presence of humans may cause displacement or change in behavior of wildlife, both temporary and permanent, through proximity to habitat, habitual use of an area (e.g., trails), or through direct harassment (Trulio et al. 2013; Shannon et al. 2014). There may also be effects on wildlife behavior from nighttime outdoor recreation activity, including light and sound pollution, or other disturbances associated with these recreational activities. Littering can have both direct and indirect effects (Boarman 2002), and bringing pets to open space and other types of protected areas may also cause direct and indirect impacts to wildlife species (Reed and Merelender 2008; Reilly et al. 2017).

However, despite more than 40 years of research on this topic, significant information gaps exist. The purpose of this article is to: 1) summarize what is known about effects on non-consumptive recreation on wildlife, 2) summarize current management practices used by park and recreation agencies in the San Francisco Bay Area to manage public access to protect wildlife, and 3) suggest additional research that will help fish and wildlife managers as well as park and open space managers more effectively manage and respond to potential impacts of non-consumptive outdoor recreation on wildlife species and their habitats.

CURRENT STATE OF THE KNOWLEDGE

Overall state of the knowledge

To preliminarily identify potential data gaps and long-term trends in the literature, we searched Google Scholar for articles containing the keywords "non-consumptive recreation" and "wildlife" at ten-year increments from 1980 to 2019. We subsequently performed the same query substituting "plants" for "wildlife." We identified 515 results containing the keywords "non-consumptive recreation" and "wildlife" between 1980 and 2019. Of these, 26 (5%) were published in the 1980s, 82 (16%) in the 1990s, 170 (33%) in the 2000s, and

237 (46%) in the 2010s. The same search with "plants" substituted for "wildlife" yielded 298 results between 1980 and 2019—15 (5%) in the 1980s, 44 (15%) in the 1990s, 105 (35%) in the 2000s, and 134 (45%) in the 2010s.

It is clear that the number of articles related to non-consumptive recreation and plant and wildlife management has increased over time, and that wildlife is consistently more studied than plants. More granular trends in the literature are less immediately apparent. We therefore identified several comprehensive literature reviews from the last 40 years to better understand which topics in plant and wildlife management are most often studied. In particular, we sought out reviews that would elucidate long-term trends in which types of recreational activities are the most studied, whether response variables are typically quantified at the individual or population level, which taxa are the most studied, and other trends that may inform the scope of future research. Due to the higher volume of studies available on wildlife than plants, we focused our efforts on wildlife-centered articles.

Boyle and Samson (1985) conducted a comprehensive review of the state of knowledge in which they identified trends in studies containing original data on terrestrial vertebrates in North America (n = 166). These articles most often studied birds (103, 62%), followed by mammals (70, 42%), with few studies of herpetofauna (7, 4%). Boyle and Samson reported negative effects for most activities and taxa, postulating potential mechanisms such as direct disturbance and indirect effects such as habitat degradation, noting that the latter may result in simpler vegetation profiles and overall loss of habitat diversity. Positive effects on overall biodiversity were reported in a few studies, but these positive effects typically corresponded with increased abundance and diversity of common species well-adapted to frequent disturbance by humans. Based on data gaps identified through their review process, Boyle and Samson concluded that primary shortcomings in the literature included a lack of experimental, rather than observational data, and a need to move from assessment of disturbance and mortality to analysis of long-term ecological effects (Boyle and Samson 1985).

A more contemporary review conducted by Larson et al. (2016) analyzed 280 articles on the effects of non-consumptive recreation and wildlife. This review was broader in scope than that of Boyle and Samson, including a wider swath of recreational activities and all taxa globally. Although these results are not directly comparable due to differences in scope, Larson et al. identified similar trends to Boyle and Sampson 31 years earlier. The researchers found that articles remained mostly observational, with only 30% of articles containing an experimental component. Among the articles included in their review (n = 280), mammals were studied the most often (114, 42%), followed closely by birds (101, 37%). A wide gap was observed between mammals and birds and invertebrates (34, 12%), herpetofauna (17, 6.2%), and fish (14, 5.1%). Notably, the authors found that the majority of species studied with International Union for Conservation of Wildlife (IUCN) status were classified as species of least concern, and that endangered, critically endangered species, and data-deficient species were the least often studied. Similar to Boyle and Samson, most studies evaluated identified significant effects of non-consumptive recreation on wildlife, with negative effects being the most frequent. Most studies that showed unclear results as to whether effects were positive or negative had a behavior-based response variable, demonstrating the challenges associated with interpreting behavioral responses (one of which is the potential for wildlife to habituate to recurring, non-threatening recreational use), and the implications for long-term ecology and land management (Larson et al. 2016).

Most studies on the effects of non-consumptive recreation on wildlife were conducted

in North America (Larson et al. 2016). In a paper on recreation impacts on wildlife submitted to the federal Interagency Visitor Use Management Council (IVUMC), Marion (2019) summarized the current state of research, with results falling into five broad categories. The categories included: 1) type of recreational activity; 2) recreationist behavior; 3) impact predictability; 4) impact frequency and magnitude; and 5) impact timing and duration. In regard to category one, Marion found mixed results on impacts from slow versus fast (e.g., walk, run, mountain bike, motorized vehicles) recreation activities. Regarding category two, he found visitors who directly approach wildlife are perceived as threatening, and wildlife are less disturbed by recreation travel that is slow, quiet, and in directions parallel to or away from them. Marion also found that wildlife are able to adapt to and tolerate consistent nonthreatening recreational activities, but unpredictable recreational activity in less visited off-trail locations can cause greater impact (category three). Repeated human interaction and disturbance of wildlife can exceed a threshold of tolerance that causes wildlife to leave a preferred habitat (category four). In regard to category five, Marion found wildlife show locational and seasonal sensitivities to recreation. Marion then describes multiple strategies to manage recreation to minimize impacts on wildlife, which are summarized later in this paper.

California-focused research

California plays an important role in this body of research due to its abundant biodiversity and large areas of protected and/or publicly-owned lands. California has been relatively well-studied, with most research focused on birds, and more recently mammalian carnivores. The discussion below is not intended to be exhaustive but rather to summarize the findings of representative research efforts with implications for recreation and wildlife management and provide context for on-the-ground practices and recommendations, with a focus on California.

In the San Francisco Bay Area, several studies on avian wildlife have emerged in recent years. A 2008 study on foraging shorebirds and trail use found no change in behavior or species diversity during trail use (Trulio and Sokale 2008). These findings indicate foraging shorebirds at regularly used trails may habituate to human activity. However, other experimental studies have found that shorebird numbers decreased with human presence on trails (Trulio et al. 2013), and that trail uses such as jogging and dog walking can increase flight distance (Lafferty 2001). Differences in shorebird response to human disturbance are likely attributable to the birds' degree of habituation to human disturbance. Studies indicate that shorebirds in areas of more frequent human disturbance display less response to human activity; although, birds tend to use these areas at lower rates than areas with less disturbance (Josselyn et al. 1989). Trulio et al. (2013) recommended keeping trail users at least 50 m from foraging habitat. They also suggested that infrequent trail use may be more disruptive to birds then frequent trail use, indicating that habitation may occur as referenced above. Similarly, Miller et al. (1998) found the composition and abundance of birds to be altered in a Colorado grassland and forest setting, with an area of influence of approximately 75 m (zone where human activity may displace wildlife from suitable habitat).

As exemplified by these studies, even the least intrusive non-consumptive recreational activities, such as hiking and picnicking, have the potential to affect wildlife. Reed and Merenlender (2008) examined this possibility in the context of mammalian carnivores in the Northern San Francisco Bay Area. They consistently found that sites where quiet, non-

consumptive recreation is permitted had lower density of native mammalian carnivores than areas with no recreation. All recreational sites showed a shift in carnivore detections toward non-native carnivores such as domestic dogs and cats (Reed and Merenlender 2008). These results corroborate the relatively consistent finding that the mere presence of humans and their introduced domestic species may prove detrimental to native wildlife, regardless of the types of recreation in which they engage.

The finding that community composition shifted toward non-native species such as domestic dogs where recreation was permitted suggests a need to better understand the effects of dogs on native wildlife and the efficacy of various dog management strategies. This need is furthered by the outsized role dogs tend to play in open space management efforts. To follow up on their previous findings, Reed and Merenlender (2011) further studied the effects of different dog management policies in recreation areas. They found no significant differences in mammalian carnivore abundance or species richness between recreational sites with no dogs, sites with on-leash dogs, and sites with off-leash dogs. They did, however, identify significant differences between all three types of sites and reference sites with no recreation, suggesting that the presence of humans is a more important influence on species diversity and carnivore density than that of dogs (Reed and Merenlender 2011).

MANAGING PUBLIC ACCESS TO PROTECT WILDLIFE

To better understand whether trends identified in the literature are translated to open space management practice, we obtained information from local park, recreation, and open space area managers on how they address public access and its potential impacts on wildlife. Due to the abundance of literature focusing on the region and the richness of open space availability and biodiversity in close proximity to urban populations, we focused this effort on the San Francisco Bay Area.

Case study on San Francisco Bay Area open space management strategies

To assess current practices in addressing biological constraints in public access management and to identify how principles elucidated in the literature are applied in practice, we conducted a case study based on information obtained from ten open space management entities in the San Francisco Bay Area. Four of these were special districts, four were county agencies, and two were non-profit organizations. Each organization is identified numerically in the following discussion for the purposes of anonymity. All organizations were contacted by email in September 2019 and provided a survey with a standardized set of questions on public access management approach in areas known to contain sensitive biological resources. Each organizations' webpage was subsequently queried for supplemental information.

Five of ten organizations contacted via email responded to initial outreach efforts. Of these, three indicated that they restrict recreational access to some or all of their lands based on the presence of sensitive biological resources (County Two, Special Districts Two and Three). The other two respondents said they do not restrict access on any of their lands (Special District Four) or that they entitle open space preserves but do not hold land in the long-term or provide access opportunities (Non-Profit One).

County Two's response suggests limitations in their capacity to restrict public access for the purposes of addressing biological constraints. This County was in the process of de-

veloping a dog policy to determine where dogs are permitted and where leashes are required. In describing this policy, County Two representatives did not specify any biological factors being considered. Outside of its dog policy, the County indicated that they may restrict park access due to wet weather or public safety concerns; but that they generally do not restrict access for biological reasons apart from seasonally fencing off a small portion of one park for nesting shorebirds. In describing their shorebird protection efforts, representatives stated that they only restrict access insofar "as that is allowed."

Webpage queries of all 10 organizations demonstrated that a management approach similar to County Two's was common. There was little indication of restricted recreational access such as permit-only areas or seasonal park or trail closures to address biological constraints, with dog policies being the most common strategy to protect wildlife. Most permits were related to facility rental or special event production, with some parks containing sensitive plant species also providing scientific collection permits. Furthermore, most seasonal trail closures cited severe weather and trail washouts, and few were explicitly tied to biological concerns. Among the organizations surveyed, restricting the presence of dogs in parks was the most common strategy used by land managers to reconcile potential incompatibilities between non-consumptive recreation and sensitive species protection. Virtually all organizations had some type of dog policy in place or were in the process of establishing a dog policy. More than half of them specifically cited disturbance of wildlife or other biological constraints when describing dog access restrictions. Policies ranged from outright prohibition of dogs to requirements that dogs be kept on leashes.

Special District One was a notable exception to the patterns described above. In addition to restrictions on dogs, this organization employed a variety of methods, including permit-only access areas and seasonal trail and road closures. Special District One maintains one area that can only be accessed by permit holders. This area provides habitat for special-status avian species and other non-special status wildlife species. Recreational activities in this area are restricted to camping, hiking, horseback riding, and backpacking, and permits must be purchased in advance. Hunting is not allowed. Additionally, Special District One closes portions of one park annually for raptor nesting, and at the time of writing, one other park had trail closures for unspecified habitat protection. Special District One indicated in its response to outreach efforts that it annually and occasionally employs this technique as needed, closing trails and roads based on the presence of wildlife during sensitive windows such as nesting or mating. Moreover, correspondence with this District indicated that they purchase lands in collaboration with conservation organizations and place these lands under easement, and that when these lands become publicly accessible, permissible recreational activities are limited to those compatible with applicable habitat conservation plans. In addition to these strategies and similarly to other organizations, Special District One provides restrictions on where and how dogs may be present on their land. Biological considerations incorporated in this District's dog policy included prohibition on dogs where specified by conservation easements and in sensitive habitats such as marshes and wetlands.

The two non-profit entities included in this study had management practices that were among the most wildlife-protective. Non-Profit One indicated that opportunities for public access on their lands are very limited due to their high conservation value and the organization's emphasis on preserving biodiversity—suggesting an approach placing higher value on conservation than recreation and incidentally allocating recreational opportunities where compatible with biological constraints. Perhaps the most unique management strategy

identified in our case study was employed by Non-Profit Two. This organization divided their lands into two distinctive types of preserves—with the primary purpose of one type being public outreach and education, while the other type primarily served conservation purposes. While conservation and restoration activities are held on both types of preserve, the former includes more opportunity for educational events, hiking, and community volunteer days than the latter, where public access is limited due to resource constraints.

In our outreach and website queries, we looked for permit-only access areas, seasonal trail closures, restrictions on dogs, and other management strategies. Few of the public entities included in this case study restricted recreational access permanently or seasonally to address biological constraints, with surveyed non-profit organizations doing so more holistically. Yet, most public entities indicated the presence of sensitive plant or animal species on their lands or stated conservation as one of their organization's purposes. Although this case study examines a small, non-representative sample of management entities, these findings suggest that the public land management agencies that responded to our query may be constrained by mission and purpose in their ability to limit public access relative to other organizations such as non-profits with a singularly focused purpose of resource protection.

ADDITIONAL RESEARCH NEEDS

Several implications emerge from our review: 1) research efforts need to extend beyond noting individual behavioral responses; 2) more research is needed on species beyond birds and mammals; and 3) impact studies needs to be more frequently integrated with research on outdoor recreation use patterns.

The studies we reviewed indicate that although some research has been conducted on the effects of non-consumptive recreation on wildlife, the scope is generally narrow. There is a need for additional information on other taxa, given the number of listed species that are not birds or mammals. Moreover, recreational impacts on special status plant species are consistently less studied than those on wildlife, despite the high number of listed plant species, and the fact that habitat degradation (including impacts to vegetation) is a potential mechanism for recreation's impacts on wildlife. One example of such an investigation is the Spring Mountains National Recreation Area Landscape Analysis (USDA 2008). This report included an evaluation of spatial impacts from current and future recreation facilities on habitat loss for 30 special status species, most of which were plants. Another example is the Marin County Road and Trail Management Plan (Marin County Parks and Open Space District 2014) which included an analysis of illegally constructed mountain bike trails on special status species, most of which were plants.

Our findings suggest that individual wildlife response to recreational activity is studied more often than population-level response. One exception is experimental, longitudinal research conducted by Riffell et al. (1996), who evaluated the effects of repeated intrusion by hikers to avian communities in Wyoming's Medicine Bow National Forest for 10 weeks during the breeding season over 5 years. Their study found no cumulative or yearly declines in seasonal species richness, mean richness, or mean total abundance. They did find that repeated intrusions altered the composition of the community represented by the most common species, but no widespread impacts on avian community structure were documented. Continuing this line of research will be important to evaluate recreation impacts at the population level. This is particularly crucial given the nature of Federal and State regula-

tory schemes for endangered species, which typically take a population-based approach to species protection. Moreover, conducting research at the population level eliminates the need to interpret individual-level responses' implications for broader conservation efforts. Extrapolating individual response to a population-level context can prove difficult (Bejder et al. 2009; Caro 2007), and eliminating the need to do so reduces uncertainty for decision-makers.

Population-based outcomes should continue to be incorporated in future studies to facilitate stronger understanding of recreation's implications for conservation. While this is a more difficult undertaking than simply investigating behavioral responses, this type of research is needed to inform policies implemented by land managers. Useful models for conducting long-term, quasi-experimental research that addresses the larger question of population viability in the context of known threats, including non-consumptive recreation, to special status species exists in previous studies and can be used to inform future research.

Additionally, the taxa studied need to be prioritized to include additional groups. Mammals and birds have been studied more often than other taxonomic groups since non-consumptive recreation became a popular topic of research in the 1980s, and continue to be the most studied today. This does not necessarily correspond with greater conservation or research needs, especially considering the high number of amphibian, reptile, and invertebrate species with special status as designated by the California Department of Fish and Wildlife or the U.S. Fish and Wildlife Service (~61% of listed species in California). If park and open space managers are to make informed, high-impact conservation decisions using the limited resources available to them, research efforts must be prioritized based on conservation need rather than focusing on the most visible species. Similar work is needed to provide frameworks for prioritizing research dollars in wildlife and open space management.

Before embarking on a new vein of research to address these above areas, it may be useful to consider comments offered by Dr. David Cole and William Hammitt, from their textbook, *Wildland Recreation: Ecology and Management*. From Hammitt and Cole (2015):

> The relationship between amount of recreational use and wildlife impacts is not well understood. Very few studies have systematically examined the effects of varying numbers of visitors on wildlife. Even fewer wildlife studies have determined an accurate population count of organisms prior to the introduction of recreation…..Previous research indicates the complexity of the relationship by stating that the number of visitors cannot be considered in isolation from species requirements and habits, setting attributes, and type of recreational use. Various aspects of use intensity are also involved, including frequency and regularity of use and number of people at one time.

Thus, the third area where additional research is needed is integrated research that links specific outdoor recreation patterns to effects on species distribution and abundance. Some of this is occurring via research by Larson, Reed, Merelender, and others. For example, Larson et al. (2018) correlated recreational use levels with habitat occupancy for seven special status species for 18 reserves in San Diego County. This is a thorough research effort that integrates a model to predict recreation use levels with whether habitats for special status species are occupied. A more comprehensive and robust effort is needed that extends this type of research to a variety of habitat types and recreational use levels

throughout California. Finally, the effectiveness of the "regulatory toolkit" that park, recreation, and open space managers have to control outdoor recreation use is well-established for federal lands, but its applicability to protected areas in close proximity to urban areas is largely unknown. Marion (2019) mentions strategies on how to address recreation impacts to wildlife including: reducing use, modifying the timing and location of use, modify the type of use, visitor behavior and expectations, and maintain and/or rehabilitate the resource. In regard to modifying visitor behavior, there is an entire body of research that focuses on how well visitors comply with wilderness and other protected area regulations (Lucas 1981; Washburne 1982; Duncan and Martin 2002; Marion and Dvorak; Martin and McCurdy 2010), and a review of low impact education programs (Marion and Reid 2007), such as Leave No Trace, suggests these programs can be effective at altering visitor behaviors that can cause impacts to natural resources. However, what has not been well investigated is how widespread such programs are implemented by park, recreation, and open space managers, and their applicability to open space preserves near urbanized areas.

Furthermore, it is important for research to go beyond theory and be adopted into practice by land managers. Research findings must be placed into a conservation and management context, with actionable priorities and recommendations for park, recreation, and open space managers. Researchers should engage with park and open space managers to ensure that science-based policies are enacted. Although limited in scope, our case study indicates some potential disconnects exist between the scientific community and on-the-ground open space management entities. For example, a large portion of the San Francisco Bay Area open space management and wildlife conservation efforts focused on developing sound dog policies; yet our research on the matter suggests that the effects of dogs are secondary to those of the presence of humans. Therefore, it may be of higher impact to examine ways to limit human activity in areas with sensitive biological resources through trail routing, permanent and seasonal park closures, and other methods.

Researchers and managers should therefore work together to develop, implement, and test science-based strategies. Social science-based methods should be included when testing approaches to better understand compliance with and attitude towards various management approaches as well as park use patterns. Several studies described above (Duncan and Martin 2002; Martin and McCurdy 2009) integrated these methods into their research but were focused on compliance with wilderness regulations.

Taylor and Knight (2003) demonstrated a potential approach for researchers to integrate study of park user perceptions into their work. They used a behavior-based model to study ungulate response to hikers and mountain bikers in a state park in Utah and, importantly, analyzed visitors' perceptions of their own effects on wildlife. They found that recreationists tend to attribute adverse effects on wildlife to other recreationists' actions and not their own. These results illustrate the importance of park user education as well as collaboration between the natural and social sciences in recreation and wildlife management.

Another example may be found in research conducted by Jefferson County Open Space District in Colorado, which has documented "heat maps" of recreation use for trails that bisect their open space areas. This information can then be overlaid with known or potential occurrences of special status species. Accurately collected recreation use data such as these would help biologists and park and open space managers better understand the relationship between overall park use patterns and wildlife impacts, an area of research that we found to be notably understudied.

To move toward sound management practice that effectively accommodates demand for public access and need for species protection, methodological changes and research prioritization are needed. Through review of literature related to the effects of non-consumptive recreation on wildlife and a survey of local agencies' integration of science-based methods into open space management efforts, we found that significant data gaps exist in both science and policy. New frameworks are needed to prioritize conservation efforts, which identify sensitive resources and integrate these into management efforts. Additional research using population-based response variables is necessary to quantify effects and determine whether management strategies are effective. A holistic approach incorporating conservation status and public recreational use patterns is needed to prioritize finite research and management resources.

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Author Contributions

Conceived and designed the study: JB
Collected the data: AS
Performed analysis of the data: AS
Authored the manuscript: JB, KD, AS
Provided critical revision of the manuscript: JB, KD, RC

LITERATURE CITED

Bejder, L., A. Samuels, H. Whitehead, H. Finn, and S. Allen. 2009. Impact assessment research: use and misuse of habituation, sensitisation and tolerance in describing wildlife responses to anthropogenic stimuli. Marine Ecology Progress Series 395:177–185.

Boarman, W. I. 2002. Threats to desert tortoise populations: a critical review of the literature. United States Geological Survey, Western Ecological Research Center, Oakhurst, CA, USA.

Boyle, S. A., and F. B. Samson. 1985. Effects of nonconsumptive recreation on wildlife: a review. Wildlife Society Bulletin 13(2):110–116.

California Department of Fish and Wildlife (CDFW). 2019. Threatened and Endangered Species. Available from: https://www.wildlife.ca.gov/Conservation/CESA (November 2019).

California State Parks. 2012. Survey on public opinions and attitudes on outdoor recreation in California. Available from: https://www.parks.ca.gov/SPOA (September 2019).

California State Parks. 2011. California Outdoor Recreation Economic Study: Statewide Contributions and Benefits. Available from: https://www.parks.ca.gov/pages/795/files/CA%20Outdoor%20Recreation%20Economic%20Study-State%20

Park%20System%20Contributions%20and%20Benefits%202011.pdf (November 2019).

Caro, T. 2007. Behavior and conservation: a bridge too far? Trends in Ecology and Evolution 22:394–400.

Duncan, S., and S. R. Martin. 2002. Comparing the effectiveness of interpretive and sanction messages for influencing wilderness visitors' intended behavior. International Journal of Wilderness 8(2):20–25.

Hammitt, W. E., and D. N. Cole. 2015. Wildland recreation: ecology and management. Wiley, New York, NY, USA.

Lafferty, K. 2001. Birds at a southern California beach: seasonality, habitat use and disturbance by human activity. Biodiversity and Conservation 10:1949–1962.

Larson, C. L., S. E. Reed, A. M. Merenlender, and K. R. Crooks. 2016. Effects of recreation on animals revealed as widespread through a global systematic review. PLoS ONE. 11(12):e0167259.

Larson, C. L., S. E. Reed, A. M. Merelender, and K. R. Crooks. 2018. Accessibility drives species exposure to recreation in a fragmented urban reserve. Landscape and Urban Planning 175: 61–72.

Lucas, R. C. 1981. Redistributing wilderness use through information supplied to visitors. United States Department of Agriculture, U.S. Forest Service, Intermountain Forest and Range Experiment Station. Research Paper-INT-277.

Josselyn, M., M. Martindale, and J. Duffield. 1989. Public access and wetlands: impacts of recreational use. Technical Report #9, Romberg Tiburon Centers, Center for Environmental Studies, San Francisco State University, Tiburon, CA, USA.

Marin County Parks and Open Space District. 2014. Road and Trail Management Plan. Available from: https://www.marincountyparks.org/-/media/files/sites/marincounty-parks/projects-and-plans/road-and-trail-management/system-designation-all/rtmp_final_120614.pdf?la=en (February 2020).

Marion, J. L. 2019. Impacts to wildlife: managing visitors and resources to protect wildlife. Contributing Paper prepared for the Interagency Visitor Use Management Council.

Marion, J. L., and S. E Reid. 2007. Minimising visitor impacts to protected areas: the efficacy of low impact education programmes. Journal of Sustainable Tourism 15(1):5–27.

Marion, J. L., and R. G. Dvorak. 2008. Wildlife feeding in parks: methods for monitoring the effectiveness of educational interventions and wildlife food attraction behaviors. Human Dimensions of Wildlife 13(1):429–442.

Martin, S. R., and K. McCurdy. 2009. Wilderness food storage in Yosemite: using the theory of planned behavior to understand backpacker canister use. Human Dimensions of Wildlife 14(3):206–18.

Miller, S. G., R. L. Knight, and C. K. Miller. 1998. Influence of recreational trails on breeding bird communities. Ecological Applications 8:162–169.

Reed, S. E., and A. M. Merenlender. 2008. Quiet, nonconsumptive recreation reduces protected area effectiveness. Conservation Letters 1(3):146–154.

Reed, S. E., and A. M. Merenlender. 2011. Effects of management of domestic dogs and recreation on carnivores in protected areas in Northern California. Conservation Biology. 25:504–513.

Reilly, M. L., M. W. Tobler, D. L. Sonderegger, and P. Beier. 2017. Spatial and temporal response of wildlife to recreational activities in the San Francisco Bay ecoregion. Biological Conservation 207:117–126.

Riffell, S. K., K. J. Gutzwiller, and S. H. Anderson 1996. Does repeated human intrusion cause cumulative declines in avian richness and abundance? Ecological Applications 6:492–505.

Shannon, G. L. M. Angeloni, G. Wittemeyer, and K. M. Fristrup. 2014. Road traffic noise modifies behavior of a keystone species. Animal Behaviour 94:135–141.

Taylor, A. R., and R. L. Knight. 2003. Wildlife responses to recreation and associated visitor perceptions. Ecological Applications 13:951–963.

Trulio, L. A., and J. Sokale. 2008. Foraging shorebird response to trail use around San Francisco Bay. Journal of Wildlife Management 72:1775–1780.

Trulio, L. A., J. Sokale, and D. Chromczak. 2013. Experimental study of shorebird response to new trail use in the South Bay salt pond restoration project. South Bay Salt Pond Restoration Project. Available from: https://www.southbayrestoration.org/document/ experimental-study-shorebird-response-new-trail-use-south-bay-salt-pond-restoration.

United States Department of Agriculture (USDA). 2008. Spring Mountains National Recreation Area Landscape Assessment. USDA Forest Service, Humboldt Toiyabe National Forest, Las Vegas, NV, USA.

Washburn, R. F. 1982. Wilderness recreational carrying capacity: are numbers necessary? Journal of Forestry 80:726–728.

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Wildlife occupancy and trail use before and after a park opens to the public

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We investigated changes in wildlife trail use and occupancy from baseline conditions after a park opened to the public; we were curious if wildlife would alter either their use of the trails or the surrounding areas or both in response to the park opening. We generated single-season occupancy estimates as a site-wide occupancy metric from 23 camera traps placed at 0.5 km intervals throughout the park and wildlife and human detection rates to measure intensity of trail use from 10 camera traps placed every 500 m on the trail. We compared the findings from the four seasons before to the four seasons after the park opened to the public. Human trail use increased sharply after opening and then lessened, but was markedly higher than prior to opening. Bobcat (*Lynx rufus*), coyote (*Canis latrans*) and gray fox (*Urocyon cinereoargenteus*) did not alter trail use relative to study area occupancy. Two species, black-tailed deer (*Odocoileus hemionus*) and gray squirrel (*Sciurus griseus*) altered trail use, and puma (*Puma concolor*) and wild turkey (*Meleagris gallopavo*) altered both trail and study area use. All species, except for the raccoon (*Procyon lotor*) and wild turkey, recovered to pre-opening conditions, by the winter (that is, after approximately 9 months) following opening.

Key words: camera trapping, occupancy, open space, recreational impacts, trail use

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Protected open space is considered important for conserving wildlife and providing public recreational opportunities in the San Francisco Bay Area. Recreation is often supported by concomitant trails and infrastructure, that is, that existing trails and fire roads are used by the public and, in turn, additional infrastructure is required to facilitate access. To conserve wildlife effectively, it is important to understand how wildlife may be affected by human use of the landscape even when those uses appear benign. Wildlife often share the use of trails with humans, their dogs, cyclists, motorized vehicles, and equestrians, while also

preferentially using roads and trails for movement (Whittington et al. 2005). The extent to which non-motorized recreational human uses impact wildlife that rely upon open space (for breeding, movement, foraging, etc.) is the subject of this study. Wildlife may be disturbed by human presence on trails and, as a result, vacate the surrounding landscape despite the landscape's capacity to support them. An alternate scenario may be that wildlife avoid or reduce trail use (that humans are using) but remain resident in the surrounding landscape in response to human trail use.

Wildlife can be both negatively or positively associated with human presence and zones of urbanization. Recreation has been shown to have behavioral impacts on wildlife, such as reduced feeding times (Cassirer et al. 1992), detrimental stress responses (Barja et al. 2011), reduced temporal occupancy (Wang et al. 2015), but also the reverse (Ordeñana et al. 2010; see also Reilly et al. 2016 for a review of the literature). With pressure on open space providers to accommodate human recreation and increase accessibility, understanding how access and intensity of human use affects wildlife provides essential information towards making decisions that effectively balance wildlife conservation with human interests.

We examined how public presence may affect wildlife trail use and occupancy in the surrounding landscape in the North Sonoma Mountain Regional Park and Open Space Preserve (hereafter, "Park/Preserve") in southeastern Sonoma County, California. A camera trapping array (grid) encompassed the Park/Preserve to assess changes in single season occupancy estimates (that is, we use occupancy as an index of prevalence or a surrogate of abundance in the study area; O'Brien et al. 2010; Royle and Nichols 2003; MacKenzie and Nichols 2004; MacKenzie et al. 2006; but see Burton et al. 2015 and Steenweg et al. 2018, 2019 for cautionary discussions). Additional cameras were placed on the trail to assess wildlife and human use (that is, through detection rates as a measure of intensity of use); trail construction had been completed by the time the study began.

Below we outline the key hypotheses to address the following question: How does human trail use affect wildlife trail use and occupancy in the study area?

H_0: Wildlife did not change their use of trails or residency (abundance) within the Park/Preserve after it is opened to the public. Wildlife occupancy estimates (abundance) from the grid and the trail detection rates do not change after the Park/Preserve opens to the public.

H_1: Wildlife use trails less but are still resident within the study area after the Park/Preserve is open to the public. Wildlife trail detection rates decrease after human trail use increases but occupancy estimates (abundance or residency) does not change in study area after the Park/Preserve opens.

H_2: Wildlife reduce trail use and vacate the study area after the Park/Preserve is open to the public. Both wildlife trail detection rates and site-wide occupancy decrease within the Park/Preserve after it opens to the public.

H_3: Certain types of wildlife (e.g., carnivores or ungulates) may be differentially affected by the presence of humans. With regard to trail and Park/Preserve use, see H1 and H2.

H_4: Wildlife resume a similar intensity of trail use and abundance within the study area after a period of time post-opening compared to pre-opening measures (latency to habituation). Wildlife trail detection rates decrease initially after opening, but then return to the pre-opening levels after a period of time. If wildlife do leave the study area for a period of time (lower abundance), these measures (trail detection rates and occupancy estimates) will both decrease initially after Park/Preserve opening but then recover to pre-opening levels.

METHODS

Study area

The 3.4 km^2 study area, North Sonoma Mountain Regional Park and Open Space Preserve (Park/Preserve; 38.3235 N, 122.5756 W, parks.sonomacounty.ca.gov/Visit/North-Sonoma-Mountain-Regional-Park/Park-Map/) is located in Sonoma County, California, USA (Figure 1). Sonoma County Agricultural Preservation and Open Space District (SCAPOSD) acquired the property and built the 5.95 km trail that ranges in elevation from 244 m to 750 m between June 2010 to September 2012. The Park/Preserve was then transferred to Sonoma County Parks in 2014 and opened to the public on 14 February 2015. Cattle grazing occurred before and during the study in portions of the site that supported grasslands; the site had no exclusionary fencing dividing up the site.

This area is subject to a Mediterranean climate characterized by wet, cool winters and dry, hot summers. Habitats included non-native grasslands (warm grasslands), oak-bay woodland (montane hardwood), redwood forest, mixed forest with madrone (montane hardwoods), and remnants of coast live oak forest/woodland and California bay forest (Biodiversity Portfolio Report, https://www.bayarealands.org/explorer/#, Conservation Lands Network Explorer 2016, 1 December 2016; Bay Area Open Space Council 2011). Matanzas and South Fork Matanzas creeks run through the study area. The topography is characterized by the steep hillsides of Sonoma Mountain. The surrounding land use matrix is composed of low-density rural development, protected open space, vineyards, and grazed grasslands.

Study design

A north-south grid of 23 motion and heat-differential triggered camera traps, HCO SG550V IR Scouting Cameras [and replacement Bushnell Trophy Cams (model#119636c)] were set in a randomly-generated fixed array at 0.5 km intervals covering the entire Park/Preserve ("grid cameras"). We adjusted six camera coordinates by less than 200 m to fit within the study area prior to going in the field (see yellow circles on Figure 1). Species-specific single-season occupancy estimates were generated for four seasons before and after the Park/Preserve opened to the public (see Table 1). We placed ten additional cameras at 500 m intervals along the trail ("trail cameras"; Figure 1). We calculated seasonal trail detection rates (detections per 100 trap nights) as a measure of intensity of wildlife and human use for four seasons before and after the Park/Preserve was opened to the public (see Appendix I for a list of human use categories).

Camera trapping methodology.—We followed a camera trapping and data management protocol, which is a modified version from TEAM Network 2009 and O'Brien 2010. Grid cameras were uniquely identified by line letter and number (e.g., A1, A2, A3, etc.; Figure 1). We placed camera traps within 100 m of the pre-determined coordinate during field deployment. Camera traps were attached to a wooden stake or tree with a nylon strap. Camera height was standardized to detect a mammal approximately gray fox size at a distance of 2 m at a perpendicular angle. Eight of the ten trail cameras were mounted on trees, and, after the Park/Preserve opened, were outfitted with security boxes to prevent theft. We recorded location (GPS coordinates), habitat within which the camera was placed (open, closed, or mixed), and elevation during deployment. Habitat (vegetative structure) included just three

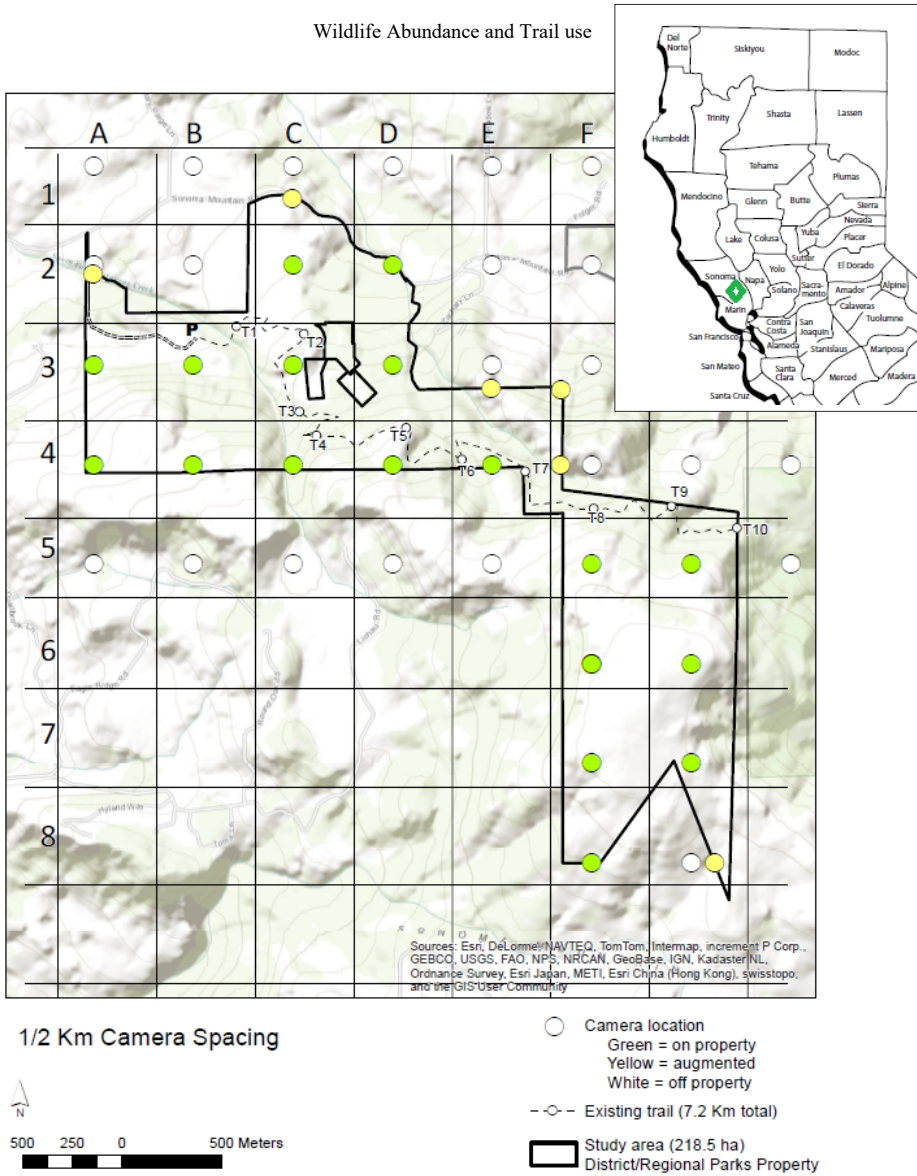

Figure 1. Camera layout for grid (yellow and green circles) and trail cameras (T1-T10) with study area location (green diamond in inset map of California counties); North Sonoma Mountain Regional Park and Open Space Preserve, California, USA, 2014–2016.

Table 1. Seasons before and after park opening, beginning and end dates for seasonal analysis, and effort (trapnights) for trail (n = 10) and grid (n = 23) camera arrays in North Sonoma Mountain Regional Park and Open Space Preserve, California, USA, 2014-2016.

Before or after opening Park/Preserve	Season	Begin and end dates	Trail trapnights	Grid trapnights
Before	Spring	1 March–30 May 2014	591	1,251
Before	Summer	1 June–31 August 2014	601	1,266
Before	Fall	1 September–31 November 2014	656	1,508
Before	Winter	1 December 2014–13 February 2015	606	1,106
Opening		*14 February 2015*		
After	Spring	1 March–30 May 2015	245	1,019
After	Summer	1 June–31 August 2015	16	701
After	Fall	1 September–31 November 2015	540	1,200
After	Winter	1 December 2015−15 January 2016	146	587

categories: closed (closed canopy), mixed (mixture of open and some overhead canopy such as oak woodland intergrading with grassland or chaparral), and open (no overhead canopy usually grassland). All cameras were set to take three images per trigger (event), a five second interval between events, 6 MP image size, high sensitivity level, and time stamp "ON." We adjusted image size and sensitivity as needed to match field conditions and improve data collection.

To verify camera station functioning during set up and maintenance, we took photographs of whiteboards with date, camera station identification, region, and subregion. We maintained camera stations regularly for proper functioning. We downloaded images from SD cards into a Windows Explorer embedded file system; EXIF image data was exported using PIE software (Picmeta v.6.75, www.picmeta.com/) into .csv files. We (authors and C. Lafayette) catalogued images to species or highest taxonomic order attainable; one of the authors (SET) vetted for accuracy during data preparation. Birds and other non-mammalian taxa were not identified to species nor included in the analysis. We categorized humans into several categories including pedestrian, cyclist, or equestrian (see full list in Appendix I). Unidentifiable images ("unknowns") and blanks were recorded as such.

Statistical analyses

We prepared a species detected list for the study area and trail compiled from before and after the Park/Preserve opened (Appendix I). We calculated single-season occupancy estimates from the camera grid and trail detection rates (detections per 100 trapnights) for terrestrial mammals (squirrel-size and larger) and wild turkeys (*Meleagris gallopavo*) from the cameras placed on trails (only). Trail cameras were not used in calculating occupancy estimates.

We calculated camera trap days ("trapnights") as the number of 24-hour periods (0000 to 2359) that the camera trap was functioning for each season [spring (March-May), summer (June-August), fall (September-November), and winter (December-February)]. We aggregated trapnights by grid and trail (Table 1) and compiled detection histories for grid cameras.

We recorded detections as the maximum number of individuals for each species in an image in a burst of three (an "event"), which are taken when the camera trap was triggered by movement and/or heat differential. For example, in a burst of three images, one image recorded two deer, in the next, three deer and in the final image, a deer; 3 deer would be recorded for that detection (maximum number of individuals in an image detected during one event).

Occupancy Analysis.—An occupancy estimate (ψ) for each species detected for the season was obtained using the program PRESENCE (v3.2, www.mbr-pwrc.usgs.gov/software/presence.html; Hines 2016). We used single-season occupancy models to estimate initial occupancy estimates (ψ) and detection probabilities (ρ) for each species (Mackenzie et al. 2003). Occupancy models account for imperfect detection and provide unbiased estimates of occupancy. To apply these models, detection histories were compiled for each species at each camera station as a series of ones (detection) and zeroes (non-detection). Each day (24-hour period commencing at 0000) the camera station was up was considered a (re)survey. Each day the camera station was "down" or not functioning was treated as a missing value.

Two pre-defined models were run, and the model with lowest delta Akaike's Information Criterion (AIC) was used to estimate probability of detection and occupancy (Hines 2016) . The first model assumes the same occupancy probability for all camera station locations and that detection probability (ρ) was constant across both camera station location and survey occasions (i.e., two parameters). The second model assumes that all camera station locations have the same probability of occupancy (ψ), but that ρ varies between the surveys—although at each survey occasion, ρ is the same at each camera station location. The software PRESENCE uses AIC to rank models (Burnham and Anderson 2002), which relies on rules of parsimony. In this case, twice the log-likelihood values at the maximum likelihood estimates were used to calculate the AIC values in model weighting.

Comparison of seasonal occupancy estimates and detection rates.— Single-season occupancy values were compared from the season before to the season after and plotted in a seasonal time series to compare to trail detection rates relative to occupancy estimates. We added linear trend lines in several time series figures to show trend from the first season (spring 2014) to the last season of the study (winter 2015-2016).

RESULTS

We set up camera traps during February 2014 and maintained them regularly until the study ended in mid-January 2016. Camera placement elevation ranged from 252 to 737 m in closed, open, and mixed habitat. Of the 23 grid cameras, four (17%) were set in closed habitat, four (17%) in mixed, and 15 (65%) in open habitat; of the 10 trail cameras, five (50%) were in closed habitat, two (20%) in mixed, and three (30%) in open habitat. The trail was located largely within closed habitat. The Park/Preserve was open (warm grasslands, 50%) with remainder mixed and closed (41.8% montane hardwoods and 6% redwood forest; Biodiversity Report, www.bayarealands.org/explorer/#, Conservation Lands Network Explorer 2016).

The composition of the wildlife community changed little from before and after the Park/Preserve opened (Appendix I). Common and expected species including large and medium-sized carnivores were detected; a California Species of Special Concern, the American badger (*Taxidea taxus*), was detected within the study area after the Park/Preserve was opened. Several rare and data-deficient species that may occur in this region were not

detected [e.g., the western spotted skunk (*Spilogale gracilis*), ringtail (*Bassariscus astutus*), porcupine (*Erethizon dorsatum*), and black bear (*Ursus americanus*)].

Seasonal analysis and effort

We generated seasonal Park/Preserve occupancy estimates and trail detection rates for eight seasons (four seasons before and after, Table 1). Trail camera trap nights averaged 425 (range = 16–656) per season. Grid trapnights averaged 1,080 (range = 587–1,508) per season. Seasonal trapping effort varied due to stolen (and replaced) camera traps, data loss due to theft of SD cards, and increased trail use filling up the SD cards with images.

Before and after seasonal comparison of occupancy estimates

Five wildlife species exhibited changes in occupancy estimates in the first season after the park opened; opossum increased (*Didelphis virginianus)* and raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), coyote (*Canis latrans*), and puma (*Puma concolor*) declined (Figure 2a) in the spring post-opening. Seven wildlife species exhibited changes in summer occupancy estimates; five decreased: striped skunk, gray fox (*Urocyon cinereoargenteus*), coyote, puma, and wild turkey (*Meleagris gallopavo*), and two increased [opossum and bobcat (*Lynx rufus*), Figure 2b] in the summer post-opening. Four wildlife species exhibited changes in occupancy estimates in the fall following opening; three decreased (gray fox, puma, and wild turkey) and one increased (opossum; Figure 2c). Only one wildlife species, raccoon, exhibited changes (increased) in occupancy estimates in the winter post-opening (Figure 2d).

Trail use

Even though the trail was not officially open to the public, some pre-opening trail use by "humans" (pedestrians, staff and trail crew) as well as their dogs and cyclists was observed in consistently low numbers (Figures 3a-c). The Park/Preserve did not allow dogs, and dog detection rates remained low throughout the study period (Figure 3c). Human trail detection rates increased dramatically immediately after the park opened; 4,393 detections per 100 trap nights (spring 2015) from 148 the season prior to opening (winter 2014–15, Figure 3a). Cyclists increased from an average of 53 (range 4–64) pre-opening to 228 (range 77–338) post-opening. Aggregated wildlife trail detection rates decreased after Park/Preserve opening (Figure 3d).

Comparing Wildlife Occupany in the Park/Preserve and on the Trail

We compared wildlife species' intensity of trail use (trail detection rates) with occupancy estimates seasonally before and after park opening.

Black-tailed deer. —Black-tailed deer occupancy increased post-opening (Figure 4a) and trail use decreased for two seasons then returned to pre-opening levels (see Figure 4b).

Gray squirrel.— Gray squirrel occupancy was stable both before and after the Park/Preserve opened to the public (Figure 4a). Gray squirrels decreased trail use post-opening summer, fall and winter from pre-opening levels (Figure 4c).

Striped Skunk.— Occupancy of striped skunks decreased (slightly) post-opening

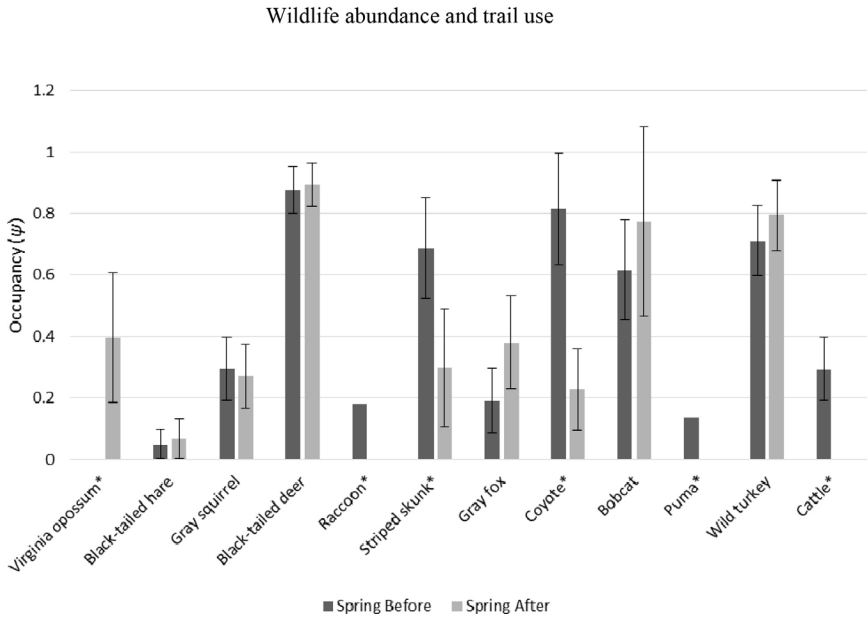

Figure 2a.

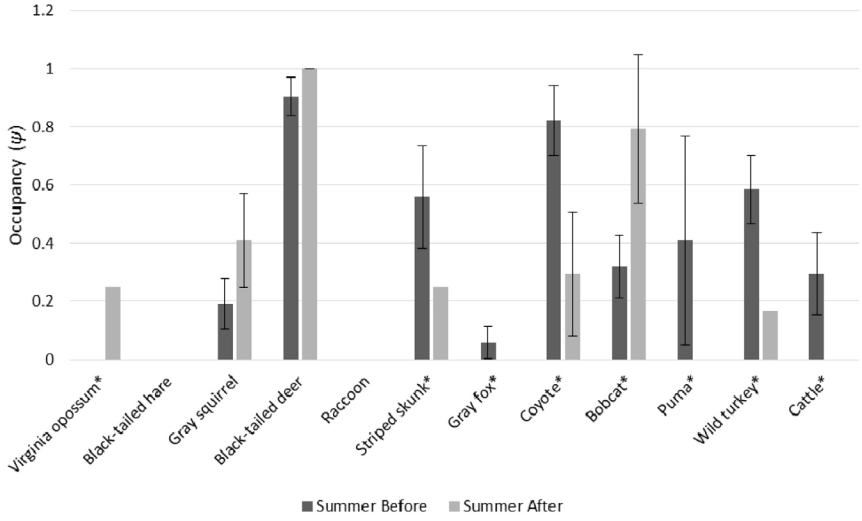

Figure 2b.

Figure 2a-d. Single-season occupancy estimates (error bars = ±SE) for wildlife species (* = difference noted between before and after occupancy estimates) in the a) spring before (2014) and after (2015), b) summer before (2014) and after (2015), c) fall before (2014) and after (2015), and d) winter before (2014_15) and after (2015_16) in North Sonoma Mountain Regional Park and Open Space Preserve, California, USA.

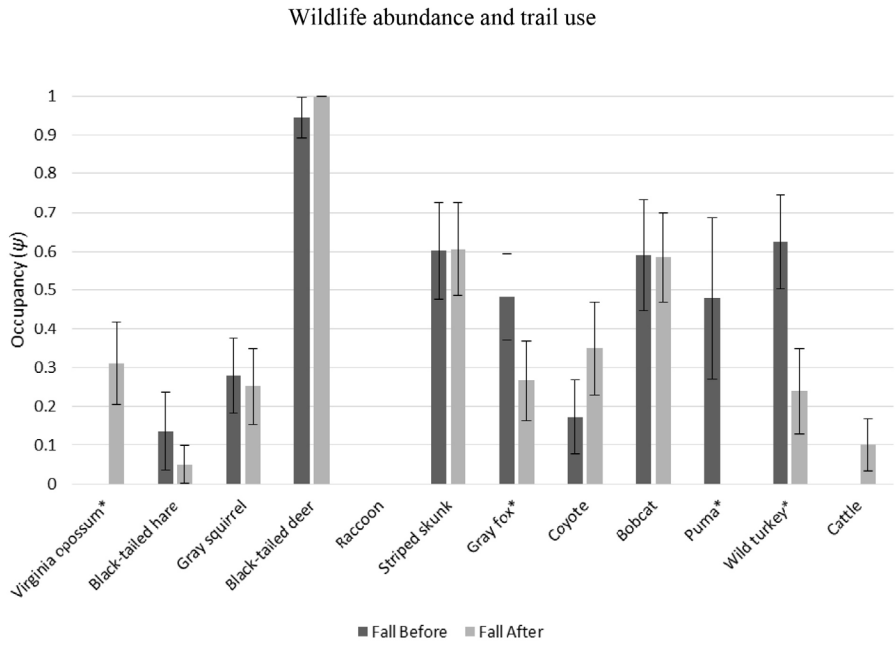

Figure 2c.

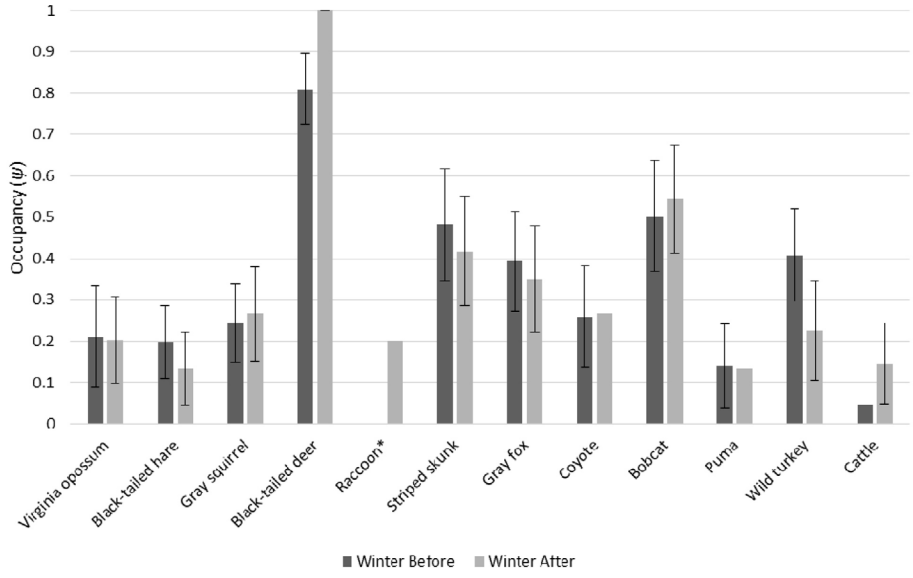

Figure 2d.

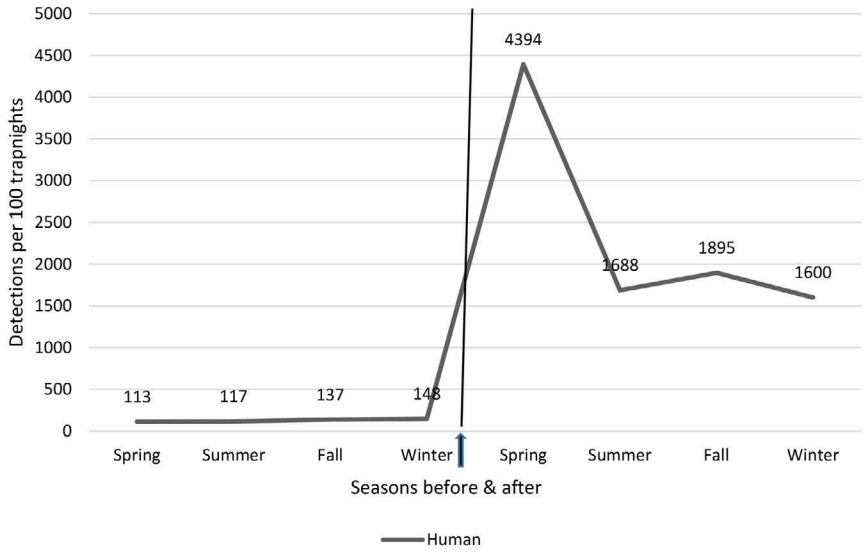

Figure 3a.

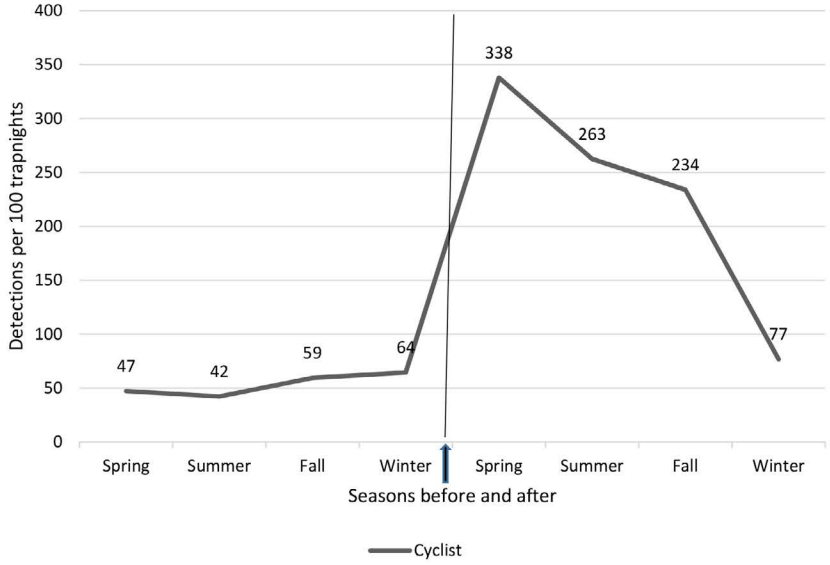

Figure 3b.

Figure 3a-d. Seasonal trail detections rates (detections per 100 trapnights) for before (spring 2014-winter 2015) and after (spring 2015-winter 2016) park opening (vertical line and arrow indicating 14 February 2015) for a) humans (non-cyclists), b) cyclists, c) domestic dog and livestock, and d) wildlife (linear = linear trend line) in North Sonoma Mountain Regional Park and Open Space Preserve, California, USA.

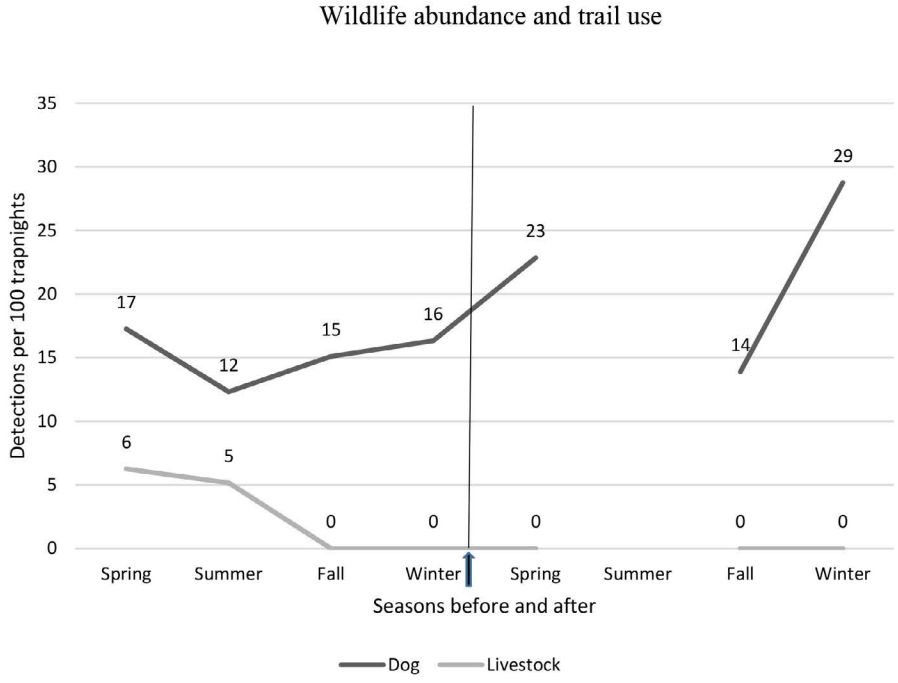

Figure 3c.

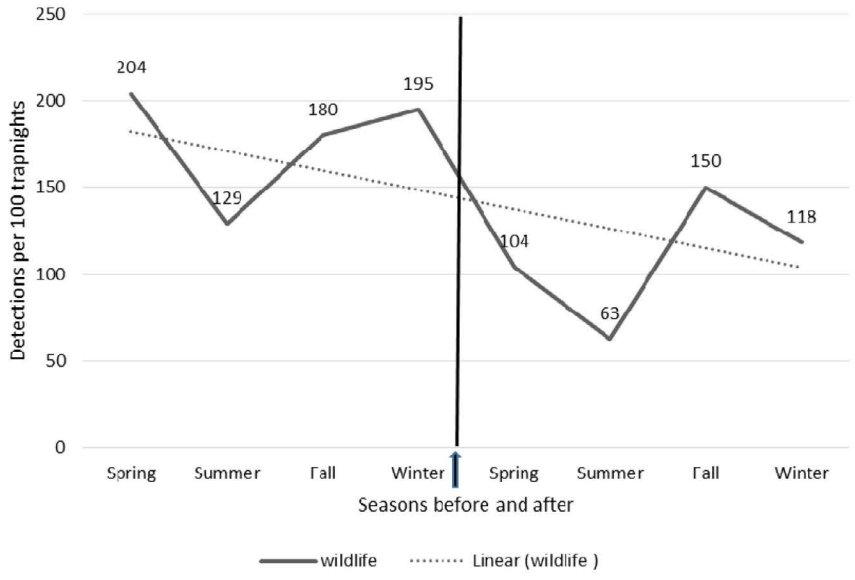

Figure 3d.

(Figure 5a). Striped skunk trail detection rates were the same post-opening for two seasons then increased to rates greater than pre-opening (Figure 5c).

Wild turkey.—Wild turkey increased in occupancy in the spring following Park/Preserve opening and decreased trail use (detection rates) post-opening (Figure 5b and 5d). Wild turkey had lower occupancy estimates and trail detection rates for post-opening summer, fall and winter.

Puma.— Puma occupancy fell to zero post-opening then increased after 3 seasons ($\psi = 0.13$, Figure 6a), potentially indicating some latency to recover. Puma decreased trail use post-opening (Figure 6c).

Bobcat.—Bobcat occupancy increased slightly in the Park/Preserve (Figure 6b) and decreased slightly in trail use (Figure 6d) post-opening.

Coyote.— Coyote occupancy decreased prior to the Park/Preserve opening and then remained relatively stable (Figure 7a). Trail use remained stable with a slight increase post-opening (Figure 7c); trail use was similar to patterns of occupancy.

Gray fox.— Gray fox occupancy was stable and similar to pre-opening occupancy (Figure 7b). Trail use was similar to patterns of occupancy (Figure 7d).

DISCUSSION

By our measures within this one study area, the wildlife that were the most affected by increased human trail use were puma and wild turkey, both decreasing in study area occupancy estimates, which we are using to detect changes in abundance and detection rates, which we are using as a measure of intensity of trail use. Additionally, the striped skunk notably increased trail use the third (fall) and fourth (winter) season after Park/Preserve opened. After two seasons post-opening, bobcat, gray fox, and coyote (three common mesocarnivores) appeared to be unaffected by public trail use both in abundance (as measured by occupancy estimates as an index of prevalence in the Park/Preserve) and trail use; these findings are consistent with a recent San Francisco Bay Area study (Reilly et al. 2016). The puma, which was present before the Park/Preserve opened, was then notably absent for three subsequent seasons post-opening. The majority of wildlife with the exception of the raccoon returned to previous occupancy levels the winter following opening (that is, after 9 months, Figure 2d).

Bobcat, coyote, and gray fox (mesocarnivores) showed little change in trail use, measured by camera detection rates on trail,and within the study area as indicated by by occupancy estimates from pre-opening measures, which support the null hypothesis, $H_{\emptyset}$ (Table 2); that is, that public trail use (at the rates we measured) did not appear to affect these species. Deer and gray squirrel showed decreased trail use despite no change in study area abundance post-opening, supporting H_1 that states that species change their trail use but not their overall use of the study area as measured by occupancy estimation. Puma and wild turkey decreased both trail use and abundance supporting H_2, which states that species will be affected by human trail use both on the trail and in the study area. Striped skunk increased trail use two seasons after opening and slightly decreased in abundance in the study area (see Table 2, Figures 5a and 5c). Deer may also have exhibited latency to habituation because their trail use resumed to pre-opening rates after two seasons (although it should be noted that human use declined; Figure 2a). Puma indicated latency to habituation for Park/Preserve abundance (Figure 6a).

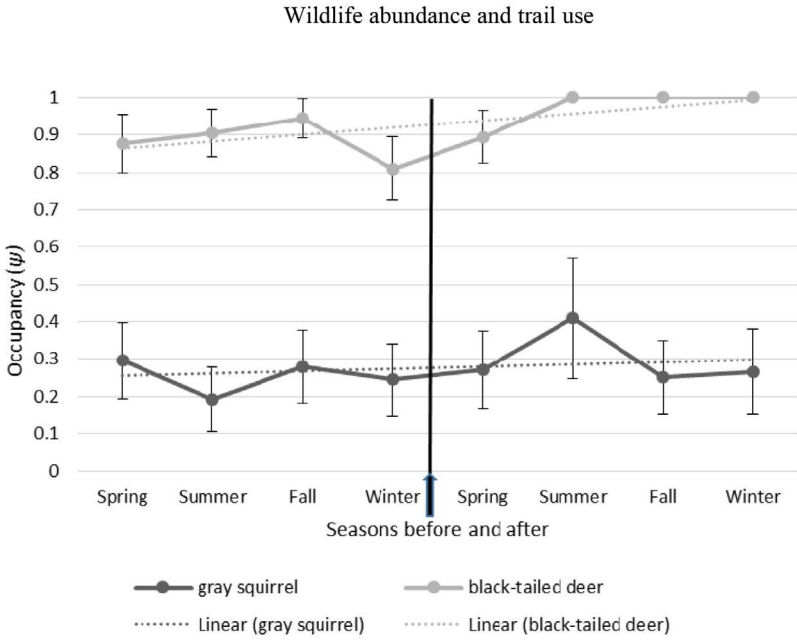

Figure 4a.

Figure 4a. Black-tailed deer and gray squirrel single-season occupancy estimates (ψ; error bar = ±SE, no error bar = no standard error) for seasons before (spring 2014–winter 2015) and after (spring 2015–winter 2016) opening (vertical line and arrow indicating 14 February 2015) in North Sonoma Mountain Regional Park and Open Space Preserve, California, USA.

In contrast to our findings, Reed and Merenlender (2008) conducted a study in the same region and found coyote and bobcat scat prevalence, as an indicator of animal presence, to be five times lower in protected areas that allowed recreation compared to sites that did not. Reilly et al. (2016), however, point out that carnivore scats are problematic as a surrogate for carnivore density because domestic dogs can consume these scats. Additionally, the human ability to visually detect scat is extremely low when compared to trained scat dogs for this purpose (i.e., humans detect only a very small fraction of scat that are present; Smith et al. 2005, Oliveira et al. 2012). Our findings were consistent with Reilly et al. (2016) that mesocarnivores appeared largely unaffected by public access and, additionally, that striped skunks increased trail use with recreational trail use.

The puma is the largest carnivore in the San Francisco Bay Area and is thought to play an important role in the ecosystem. Pumas are used as a surrogate to examine overall connectivity in the landscape due to its large body and home range size. Wang et al. (2015) examined puma behavioral responses to development and roads. According to their study, communication and denning required a four times larger buffer from human development. Findings from our study show a pattern of avoidance, at least, initially; pumas were detected very infrequently or not at all from the study area with commensurate lower trail use for three seasons post-opening; this finding was in contrast to puma adults and young consis-

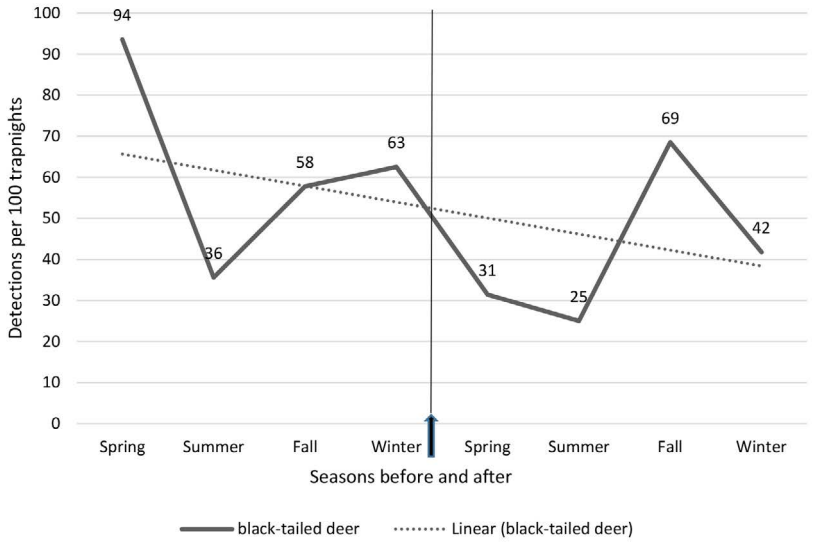

Figure 4b.

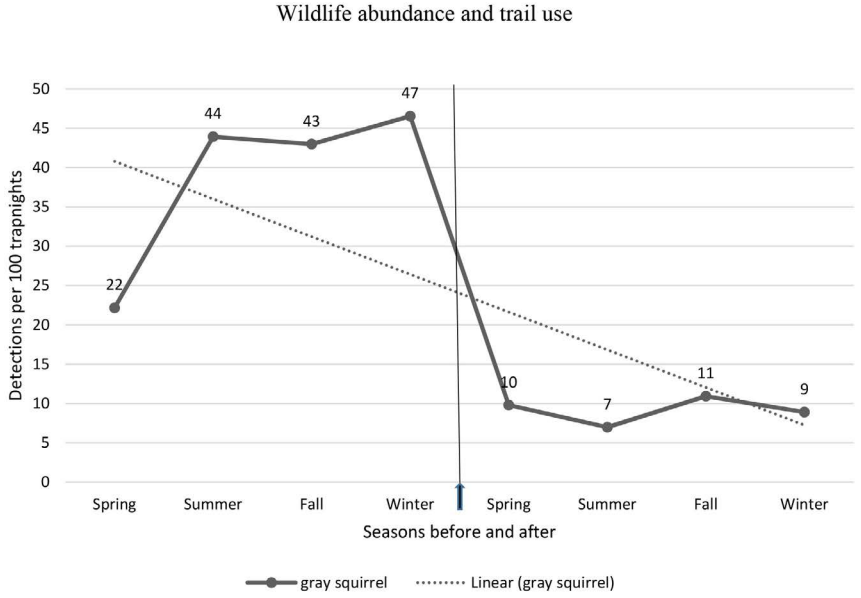

Figure 4c.

Figure 4b-c. Trail detection rates (detections per 100 trapnights) for b) black-tailed deer and c) gray squirrel for seasons before (spring 2014–winter 2015) and after (spring 2015–winter 2016) opening (vertical line and arrow indicating 14 February 2015) in North Sonoma Mountain Regional Park and Open Space Preserve, California, USA. Linear indicates linear trend line.

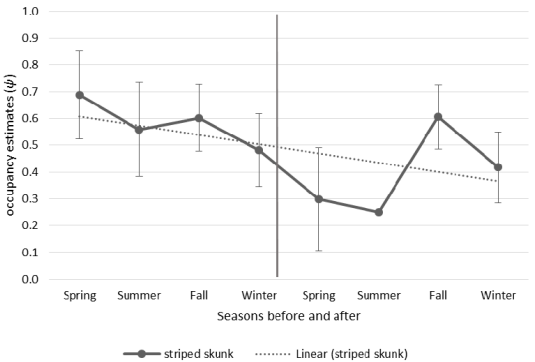

Figure 5a.

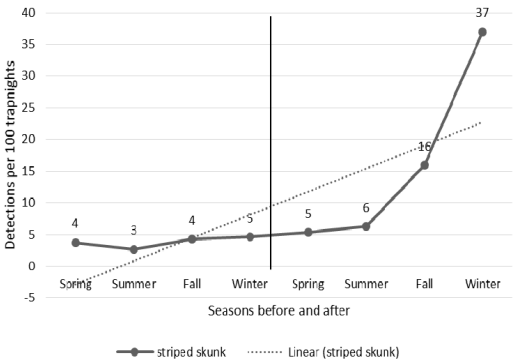

Figure 5c.

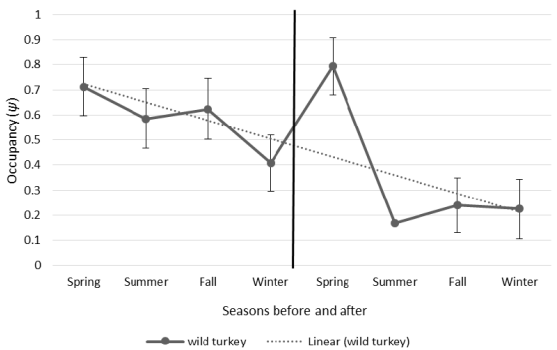

Figure 5b.

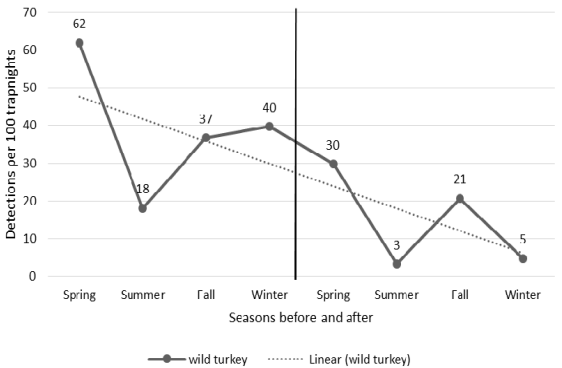

Figure 5d.

Figure 5a-b. Single-season occupancy estimates (ψ; error bar = ±SE, no error bar = observed occupancy) before (spring 2014–winter 2015) and after (spring 2015–winter 2016) opening (vertical line indicating 14 February 2015) for a) striped skunk and b) wild turkey in North Sonoma Mountain Regional Park and Open Space Preserve, California, USA. **Figure 5c-d.** Trail detection rates (detections per 100 trapnights) before (spring 2014–winter 2015) and after (spring 2015–winter 2016) opening (vertical line indicating 14 February 2015) for c) striped skunk and d) wild turkey in North Sonoma Mountain Regional Park and Open Space Preserve, California, USA. Linear indicates linear trend line.

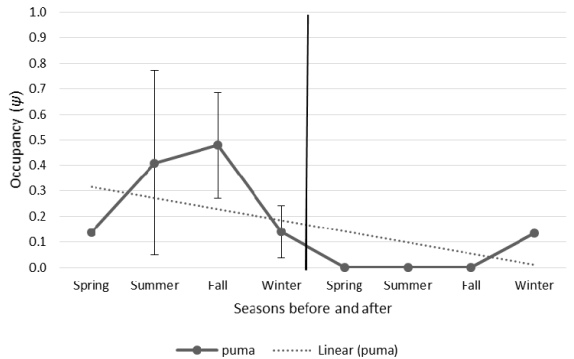

Figure 6a.

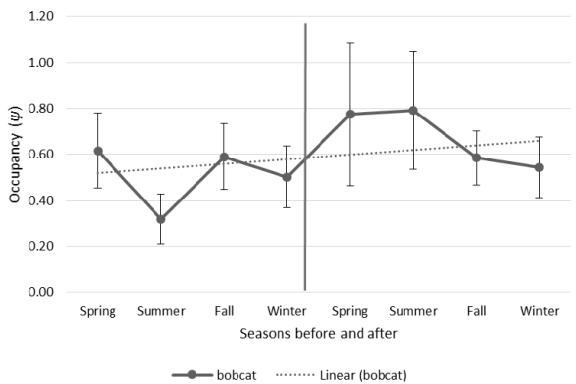

Figure 6b.

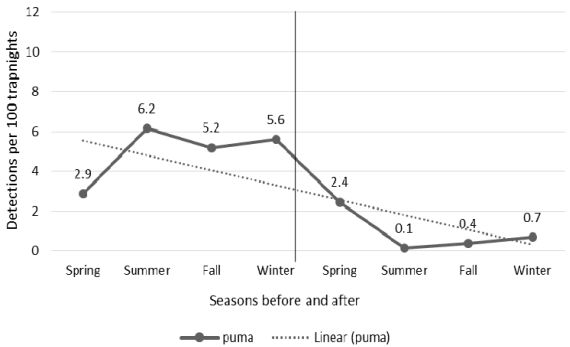

Figure 6c.

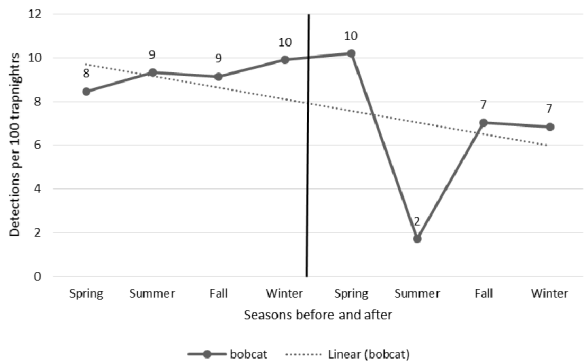

Figure 6d.

Figure 6a-b. Single-season occupancy estimates (ψ; error bar = ±SE, no error bar = observed occupancy) for seasons before (spring 2014–winter 2015) and after (spring 2015–winter 2016) opening (vertical line indicating 14 February 2015) for a) puma and b) bobcat in North Sonoma Mountain Regional Park and Open Space Preserve, California, USA. Figure 6c-d. Trail detection rates (detections per 100 trapnights) before (spring 2014–winter 2015) and after (spring 2015–winter 2016) opening (vertical line indicating 14 February 2015) for c) puma and d) bobcat in North Sonoma Mountain Regional Park and Open Space Preserve, California, USA. Linear indicates linear trend line.

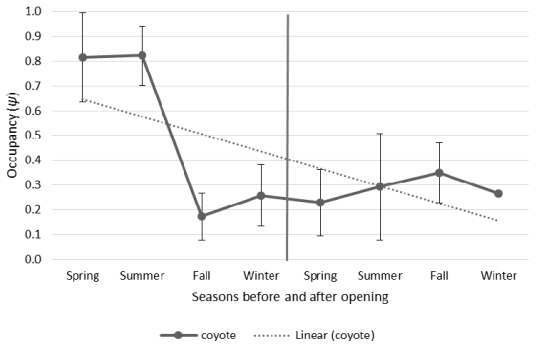

Figure 7a.

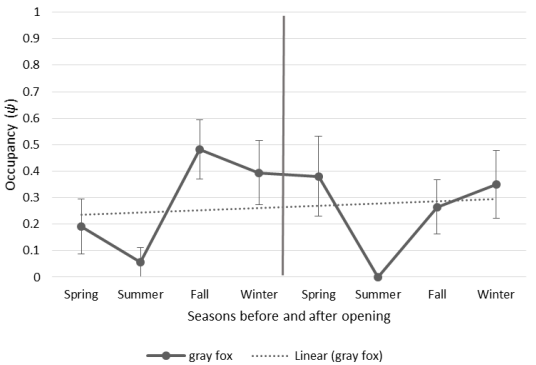

Figure 7b.

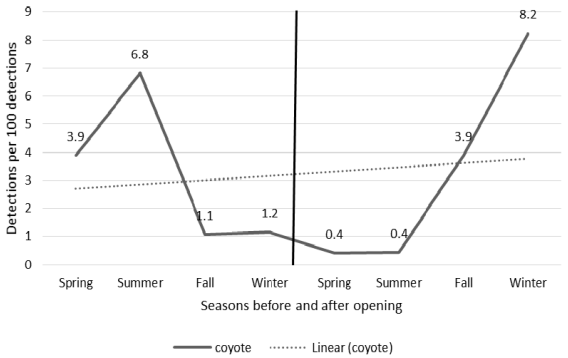

Figure 7c

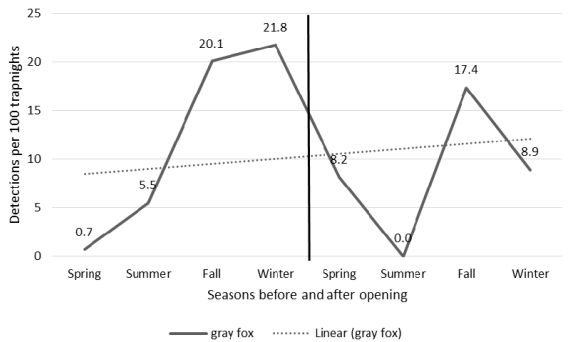

Figure 7d.

Figure 7a-b. Single-season occupancy estimates (ψ; error bar = ±SE, no error bar = observed occupancy) before (spring 2014–winter 2015) and after (spring 2015–winter 2016) opening (vertical line indicating 14 February 2015) for a) coyote and b) gray fox in North Sonoma Mountain Regional Park and Open Space Preserve, California, USA. Figure 7c-d. Trail detection rates (detections per 100 trapnights) before (spring 2014–winter 2015) and after (spring 2015–winter 2016) opening (vertical line indicating 14 February 2015) for c) coyote and d) gray fox in North Sonoma Mountain Regional Park and Open Space Preserve, California, USA. Linear indicates linear trend line.

Table 2. Which hypotheses are supported for selected wildlife species [Column headings: No change = no difference in trail use or Park/Preserve occupancy, Trail only = differences observed in trail use but not in Park/Preserve occupancy, Trail/Grid = differences observed in trail use and Park/Preserve occupancy, and Latency = recovery to pre-opening trail use and/or Park/Preserve occupancy values]. Under "Trail/Grid," minus sign indicates a decline and a plus sign indicates an increase for each respective array. An "X" indicates findings support the hypothesis. North Sonoma Mountain Regional Park and Open Space Preserve, California, USA, 2014-2016.

	Hypotheses			
Common name	No change ($H_{ø}$)	Trail only (H_1)	Trail/Grid (H_2)	Latency (H_4)
Bobcat	X			
Coyote	X			
Gray fox	X			X?
Deer		X		X
Gray squirrel		X		
Puma			X-/-	X?
Striped skunk			X+/-	
Wild turkey			X-/-	

tently present in all seasons before the trail opened. Camera trap images of puma from the pre-opening year frequently had a mother with cubs or almost fully adult offspring.

Our study area represents an area with low to moderate human disturbance (both recreational and agricultural); therefore, the wildlife in our study have had exposure to humans, roads and other infrastructure. Naïve wildlife from more pristine areas (free from human influence) may behave differently to human presence on trails and may be affected for longer period of time and in a larger area; this factor (exposure to human influence) should be accounted for when planning trails and increasing recreational access. Undeveloped open space surrounding trails provides a buffer so wildlife can (initially) move away from novel human presence or disturbance even if they are able to habituate to human trail use over time. Certain species such as pumas may require large trail free "zones" near trails to habituate over time and to successfully fulfill the full suite of life history activities such as hunting, reproduction and raising young.

Finally, for this specific study area and trail, wildlife was documented using trails even with a marked increase in human use (pedestrians, cyclists and equestrians); wildlife trail use did not drop to zero with the exception of wild turkeys and puma (at least for 3 of the 4 seasons following opening). Additionally, the apparent habituation after a period of time indicated that much of the local wildlife community, but not all, may be resilient to an increased presence of humans on a trail given time to adjust; it also should be noted that the cyclist detection rates decreased to pre-opening levels of use by the 4th season after opening, so as an alternative explanation, wildlife trail use may be able to tolerate relatively high levels of human use (1600 detections per 100 trapnights) with lower levels of cyclists (77 detections per 100 trapnights compared to a high of 338 after opening)

Land acquisition and preservation can go a long way toward ensuring future open space for wildlife; however, without commensurate wildlife monitoring, particularly for things like trail building and increased human access, with concomitant changes occurring in the surrounding landscape (e.g., traffic intensity, climate change, development, fencing), the actual benefit of that land to wildlife over time will remain unknown. From a management perspective, this "unknown" is a lost opportunity. Identifying thresholds of human use beyond which wildlife or particular species are unable to adjust may differ with various disturbance regimes and for different life history needs (e.g., foraging and movement versus breeding). Determining these thresholds and for which species are important next steps in understanding the impacts of recreationalists on wildlife. Through studies that capture pre-impact conditions as well as a post-impact timeframe that is meaningful for wildlife, open space effectiveness as a conservation tool can be measured, evaluated and improved.

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Author Contributions
Conceived and designed the study: SET
Collected the data: SET, SH, MH
Performed the analysis of the data: SET
Authored the manuscript: SET
Provided critical revision of the manuscript: SH, MH, SH

LITERATURE CITED

Barja, I., G. Silván, L. Martínez-Fernández, and J. C. Illera. 2011. Physiological stress responses, fecal marking behavior, and reproduction in wild European pine martens (*Martes martes*). Journal of Chemical Ecology 37:253−259.

Bay Area Open Space Council. 2011. The Conservation Lands Network: San Francisco Bay Area Upland Habitat Goals Project Report. Berkeley, CA.

Burnham, K. P., and D. R. Anderson. 2002. Model Selection and Multimodel Inference. 2nd edition. Springer-Verlag, New York, New York, USA.

Burton, A. C., E. W. Neilson, D. Moreira, A. Ladle, R. Steenweg, J. T. Fisher, E. Bayne, and S. Boutin. 2015. Wildlife camera trapping: a review and recommendations for linking surveys to ecological processes. Journal of Applied Ecology 52:675– 685.

Cassirer, E. F., D. J. Freddy, and E. D. Ables. 1992. Elk responses to disturbance by cross-country skiers in Yellowstone National Park. Wildlife Society Bulletin 20:375−381.

Conservation Lands Network Explorer. 2016. Biodiversity Portfolio Report generated December 1. The Explorer Tool. https://www.bayarealands.org/explorer/#.

Hines, J. E. 2016. Presence v3.2 −Software to estimate patch occupancy and related parameters. USGS-PWRC. Available from: www.mbr-pwrc.usgs.gov/software/presence.html.

Mackenzie, D. I., J. D. Nichols, J. E. Hines, M. G. Knutson, and A. B. Franklin. 2003. Estimating site occupancy, colonization, and local extinction when a species is detected imperfectly. Ecology 84:2200−2207.

MacKenzie, D. I., J. D. Nichols, J. A. Royle, K. H. Pollock, L. L. Bailey, and J. E. Hines. 2006. Occupancy Estimation and Modeling. Academic Press, Amsterdam, Netherlands.

Mackenzie, D. I. and J. D. Nichols. 2004. Occupancy as a surrogate for abundance estimation. Animal Biodiversity and Conservation 27:461 - 467.

O'Brien, T. G. 2010. Wildlife picture index: implementation manual version 1.0. WCS Working Paper No. 39.

O'Brien, T. G., J. Baillie, L. Krueger, and M. Cuke. 2010. The Wildlife Picture Index: monitoring top trophic levels. *Anim Conserv* 13: 335-343.

Ordeñana, M. A., K. R. Crooks, E. E. Boydston, R. N. Fisher, L. M. Lyren, S. Siudyla, C. D. Haas, S. Harris, S. A. Hathaway, G. M. Turschak, A. K. Miles, and D. H. Van Vuren. 2010. Effects of urbanization on carnivore species distribution and richness. Journal of Mammalogy 91:1322–1331.

Oliveira, M. L., D. Norris, J. F. M. Ramirez, P. H. F. Peres, M. Galetti, and J. M. B. Duarte. 2012. Dogs can detect scat samples more efficiently than humans: an experiment in a continuous Atlantic Forest remnant. Zoologica 29:183−186.

Reed, S. E., and A. M. Merenlender. 2008. Quiet, nonconsumptive recreation reduces protected area effectiveness. Conservation Letters 1:146−154.

Reilly, M., M. Tobler, P. Beier, and D. L. Sonderegger. 2016. Spatial and temporal response of wildlife to recreational activities in the San Francisco Bay ecoregion. Biological Conservation 207:117−126.

Royle, J. A. and J. D. Nichols. 2003. Estimating abundance from repeated presence absence data or point counts. Ecology 84:777-790.

Smith, D. A., K. Ralls, B. L. Cypher, and J. E. Maldonado. 2005. Assessment of scat-detection dog surveys to determine kit fox distribution. Widlife Society Bulletin 33:897−904.

Steenweg, R., M. Hebblewhite, J. Whittington, P. Lukacs and K. McKelvey. 2018. Sampling scales define occupancy and underlying occupancy-abundance relationships in animals. Ecology 99:172–183.

Steenweg, R., M. Hebblewhite, J. Whittington, and K. McKelvey. 2019. Species-specific differences in detection and occupancy probabilities help drive ability to detect trends in occupancy. Ecosphere 10:1–12.

Wang, Y., M. L. Allen, and C. C. Wilmers. 2015. Mesopredator spatial and temporal responses to large predators and human development in the Santa Cruz Mountains of California. Biological Conservation 190:23−33.

Whittington, J., C. Cassady St. Clair, and G. Mercer. 2005. Spatial responses of wolves to roads and trails in mountain valleys. Ecological Applications 15:543−553.

APPENDIX I. Human categories and wildlife species detected before and after park opening in each camera array for the North Sonoma Mountain Regional Park and Open Space Preserve, California, USA, 2014-2016.

Common name	Species	Grid before	Grid after	Trail before	Trail after
Human Cyclist			•	•	•
Domestic cat	*Felis sylvestris*		•		
Domestic dog	*Canis familiaris*	•	•	•	•
Equestrian		•		•	•
Hiker		•	•	•	•
Hikers with >2 dog				•	n/a
Human with dog				•	n/a
Staff				•	•
Vehicle		•	•	•	•
WPI crew		•	•	•	•
Ranger				•	n/a
Livestock					
Goats	(Goats)	•		•	•
Cattle	(Cattle)	•	•	•	
Wildlife					
Unknown	Unknown	•	•	•	•
Badger	*Taxidea taxus*		•		
Bird	(Bird)	•	•	•	•
Bat	(Bat)	•			
Black-tailed deer	*Odocoileus hemionus*	•	•	•	•
Black-tailed hare	*Lepus californicus*	•	•	•	•
Bobcat	*Lynx rufus*	•	•	•	•
Coyote	*Canis latrans*	•	•	•	•
Gray fox	*Urocyon cinereoargenteus*	•	•	•	•
Gray squirrel	*Sciurus griseus*	•	•	•	•
Opossum	*Didelphis virginiana*	•	•	•	•
Puma	*Puma concolor*	•	•	•	•
Raccoon	*Procyon lotor*	•	•	•	•
Striped skunk	*Mephitis mephitis*	•	•	•	•
Wild turkey	*Meleagris gallopavo*	•	•	•	•
Small rodent	(Small rodent)	•	•		•
Red fox	*Vulpes vulpes*			•	
Insect	(Insect)	•	•	•	
Lizard	(Lizard)	•			
Snake	(Snake)	•			

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A review of trail-related fragmentation, unauthorized trails, and other aspects of recreation ecology in protected areas

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Expanding levels of authorized and unauthorized non-consumptive recreation increasingly threaten sensitive biological resources in areas protected primarily or solely to conserve them. The majority of the documented effects on wildlife from non-consumptive recreation are negative. From a review of 84 papers in the recreation ecology literature about the effects of recreation on wildlife, the following topics emerged as warranting full consideration: trail-related internal fragmentation and expansion of the effect zone; the proliferation and use of unauthorized trails; disturbance thresholds; population-level effects; distinguishing facets of mountain biking; interpretation of observed behavioral responses by wildlife to recreation; magnitude and duration of responses; comparisons of effects among types of recreation and of results among studies; cumulative and synergistic effects; habituation; and the complexity of recreation ecology. Knowledge of these topics must inform efforts to cease the extant recreation-related exploitation of protected areas and to prevent it in the future. These efforts include: securing urgently needed perpetual monitoring, management, and enforcement commensurate with recreational pressure in dual-role protected areas to ensure the perpetuation of viable populations of focal sensitive species; preventing further use and proliferation of unauthorized trails; restoring areas damaged by inappropriate trails (i.e., unauthorized trails, unnecessarily redundant designated trails, and trails to be decommissioned); using science-based disturbance thresholds to develop management measures for recreation; using the best available science to guide all policy and decision-making about (1) the siting, design, and alignment of trails, and (2) the types, levels, and timing of recreation under consideration; and, planning separate protected areas and recreational areas in the future.

Key words: dual-role protected areas, effect zone, disturbance thresholds, internal fragmentation, mountain biking, non-consumptive recreation, perpetual monitoring/management/enforcement, recreation ecology, recreation-related disturbance to wildlife, unauthorized trails

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Conservation of habitats is a key strategy for conserving biodiversity worldwide (Pickering 2010a; Soulé and Noss 1998). The core function of many areas in California

protected for conservation is to ensure that the wildlife species living in them thrive in what is the nation's most biologically diverse state (CDFW 2015).[1] Areas protected for conservation (protected areas) include locally owned lands (e.g., county and city reserves), state-owned lands (e.g., ecological reserves, wildlife areas, state parks), federally owned lands (e.g., national wildlife refuges, wilderness areas), and privately owned lands (e.g., conservation easements, conservancy lands, mitigation banks and lands). Here, the focus is on protected areas conserved primarily or solely for the perpetuation of viable populations of sensitive species (i.e., species whose persistence is jeopardized).[2] These protected areas often serve a dual role of conserving biodiversity and providing nature-based recreational and educational opportunities for millions of people, despite the evidence that even non-consumptive recreation[3] may not be compatible with protected areas' core function (Reed and Merenlender 2008; Larson et al. 2016; Dertien et al. 2018; Reed et al. 2019).

Recreation ecology is the scientific study of the ecological effects of outdoor recreation and nature-based tourism activities and their effective management in natural or semi-natural environments (Monz et al. 2013; Gutzwiller et al. 2017).[4] Studies in recreation ecology have shown that the majority of documented responses of wildlife species to recreation are negative (Steven et al. 2011; Larson et al. 2016; Hennings 2017; Patten and Burger 2018). Recreation-related disturbance to wildlife is recognized as a threat to global biodiversity, and as having wide-ranging and, at times, profound implications for wildlife individuals, populations, and communities (Dertien et al. 2018). Documented negative effects include detrimental changes to behavior, reproduction, growth, immune system function, and levels of stress hormones, and ultimately the survival of individual animals and persistence of wildlife populations and communities.

In this review, several topics about recreation ecology became apparent as warranting full consideration.[5] These topics are (1) the major issues of trail-related fragmentation and

1 Wildlife means all wild animals: insects, fish, amphibians, reptiles, birds, and mammals.

2 These areas include areas protected pursuant to Natural Community Conservation Plans and/or Habitat Conservation Plans (NCCPs/HCPs). An NCCP is a comprehensive, single- or multi-jurisdictional plan that provides for regional habitat and species conservation at an ecosystem level while allowing local land use authorities to better manage growth and development. Upon issuing an NCCP Permit, the California Department of Fish and Wildlife (CDFW) can authorize take of certain state listed species and other species of concern, subject to the terms of coverage under the NCCP (CDFW 2015). An HCP is the federal counterpart to an NCCP; the U.S. Fish and Wildlife Service prepares HCPs and issues HCP permits. The terms and conditions under which an NCCP/HCP's protected areas are conserved establish the types and levels of public access that are permitted (Burger 2012). The types and levels of public access vary among the NCCP/HCP protected areas from no access to guided-only access to open access.

3 In contrast to consumptive recreation (e.g., hunting, fishing), non-consumptive recreation is generally assumed not to directly extract a resource; it includes nature and wildlife viewing, beach-going, kayaking, hiking, biking, horseback riding, and wildlife photography (Reed and Merenlender 2008; CDFW 2016; Gutzwiller at el. 2017). From here forward, "recreation" means non-consumptive recreation, unless otherwise stated.

4 From here forward, "management" includes monitoring, management, and enforcement. The level of enforcement necessary depends on the level of continual management implemented; generally, the more the management, the less enforcement is necessary. In addition, monitoring and management encompass both the natural resources and human users of the protected areas.

5 The author read 71 articles and 13 reports about the recreation-related effects on wildlife; this paper does not cite all of them. All the articles are published in peer-reviewed journals. Some of the reports were peer reviewed and all were written by or contributed to by professionals in the fields of biology or ecology, though none of the reports were published in peer-reviewed journals to this author's knowledge (e.g., Burger 2012; Hennings 2017; Dertien et al. 2018; Reed et al. 2019). And, the totals exclude documents that are not explicitly about recreation-related effects on wildlife (e.g., Taff et al. 2019) and all newspaper articles.

expansion of the effect zone, unauthorized trail creation and use,[6] disturbance thresholds, population-level effects, and distinguishing facets of mountain biking, and (2) the following aspects of recreation ecology: the interpretation of observed behavioral responses by wildlife to recreation, magnitude and duration of responses, comparisons of effects among types of recreation and of results among studies, cumulative and synergistic effects, habituation, and the complexity of recreation ecology.

This paper discusses the issues identified above to inform efforts to cease the extant recreation-related exploitation of protected areas and to prevent it in the future. These efforts include: securing urgently needed perpetual management of recreation commensurate with recreational pressure to ensure the perpetuation of viable populations of focal sensitive species[7] as intended upon establishment of the protected areas; preventing further use and proliferation of unauthorized trails; restoring areas damaged by inappropriate trails (i.e., unauthorized trails, unnecessarily redundant designated trails, and trails to be decommissioned); using science-based disturbance thresholds; using the best available science to guide all policy and decision-making about the siting, design, and alignment of trails, and about the types, levels, and timing of recreation under consideration; and, planning separate protected areas and recreational areas in the future. This paper discusses the above-listed aspects of recreation ecology for consideration in designing field studies and while reviewing recreation ecology literature.

Trail-related disturbance: fragmentation, edge effects, and expansion of the effect zone

External fragmentation.—There is much peer-reviewed literature on the ecological effects of fragmentation, a process by which once-contiguous areas of habitat are physically separated by human disturbance creating a network of isolated habitat patches (Soulé et al. 1988; Ballantyne et al. 2014; Vickers et al. 2015; Cheptou et al. 2017). Most fragmentation research worldwide has concentrated on progressive losses of natural habitat through removal of vegetation as a result of development, agriculture, and resource extraction. Physical fragmentation, in conjunction with other related factors (e.g., duration of isolation of habitat fragments, low vagility of species, loss of genetic diversity), causes the isolated areas of habitat to experience a decay of species diversity over time due to local extinctions (Soulé et al. 1988). Consequently, fragmentation is a major threat to biodiversity (Cheptou et al. 2017). This fragmentation is considered external to the protected areas within a landscape, though it influences the viability of protected areas with respect to wildlife conservation.

Internal fragmentation.—Recreational trails themselves can fragment habitat, thereby causing fragmentation that is internal to the areas they traverse (Pickering 2010a; Leung et al. 2011; Burgin and Hardiman 2012; Pickering and Norman 2017). Because of their linear nature, trails can have a greater negative effect than if the affected terrain were consolidated in a more compact form (Pickering 2010a). Complex networks of trails within protected areas

6 The literature refers to illegally created trails and constructed trail features variously as unauthorized, informal, social, unofficial, off-trail, visitor-created, user-created, and demand trails. "Unauthorized" is the term of choice here because it is the only term among these that clearly denotes the illegality of the creation and use of such trails and features.

7 Focal species are organisms whose requirements for survival represent factors important to maintaining ecologically healthy conditions; types of focal species include keystone species, umbrella species, flagship species, and indicator species. Focal species are identified for the purpose of guiding the planning and management of protected areas in a tractable way (Soulé and Noss 1998, Marcot and Flather 2007). Here, the term "focal species" is intended to include those species encompassed by the guild surrogate approach of conservation; this approach entails one member or a subset of members serving as a surrogate for other members of the guild (Marcot and Flather 2007).

can cumulatively affect nearly as much area as the above-mentioned external fragmentation (Ballantyne et al. 2014). Substantial evidence exists that trails may act as barriers to the movement of animals due to behavioral avoidance, the presence of a physical barrier, or development of a home range along the physical barrier (Burgin and Hardiman 2012). Trail density is a main factor influencing how wildlife respond to trail users and the ability of wildlife to disperse or reach seasonally important habitats such as breeding grounds (D'Acunto et al. 2018). Particularly when resulting from unauthorized trails or poorly sited and/or designed official trails, internal fragmentation can compound the negative effects of the external fragmentation in the surrounding landscape. The arterial spread of multiple cleared areas for trails within protected areas may cause losses of plant communities and ultimately result in long-term degradation of protected areas across large areas (Ballantyne et al. 2014).

Effects of trail presence on wildlife.—A likely consequence of internal fragmentation within protected areas is that the mere presence of trails, even in the absence of humans, can compromise protected areas' ability to sustain sensitive species (Pickering and Norman 2017; Baker and Leberg 2018). This is partly due to edge effects in the area of transition between two contrasting habitats, where resulting changes can occur in species abundance, community structure, and/or predation and parasitism (Zurita et al. 2012). Edge effects are major drivers of change in many fragmented landscapes (Laurance et al. 2007) and factor into the observations that internal fragmentation can restrict movement of some native animals and plants among habitat fragments and enhance the movement of invasive species along the trails (Barros and Pickering 2017). Baker and Leberg (2018) found that the presence alone of roads and trails, and not necessarily how often humans use them, had a significant negative effect on the occupancy of most of the 11 mammalian carnivore species they studied. Trails also potentially expose native animals to predators, including feral species such as the red fox (Vulpes vulpes), that penetrate natural areas by moving along the trails (Burgin and Hardiman 2012): a study on the effects of mountain biking on golden-cheeked warblers (Dendroica chrysoparia) found that the indirect effects from fragmentation and alteration of habitats from mountain biking trails may reduce the quality of the warblers' nesting habitat by increasing the vulnerability of warbler nests to predation by rat snakes (Elaphe obsoleta) and other edge-adapted predators (Davis et al. 2010). Edge effects associated with trails are known to affect other avian species similarly and to reduce the local abundance and nesting frequency of certain avian species, increase the incidence of nest parasitism by cowbirds, and affect avian vocalizations (Hennings 2017). The penetration of edge effects into the areas adjacent to trails is an aspect of internal fragmentation that underscores the ecological cost of unauthorized trails (Pickering and Norman 2017).

Trails expand the zone of effect.—Another notable consequence of trails is the expansion of the zone of effect of recreational disturbance to wildlife as habitats become more open, as occurs from the proliferation of unauthorized trails (Reed et al. 2019). In this context, "effect zones" are areas within which wildlife is disturbed by recreational activities on trails; effect zones encompass and extend beyond the area influenced by edge effects. The expanse of effect zones likely varies depending on the types and intensities of recreation and therefore may not be consistent across a trail network (Reed et al. 2019). Particularly in urbanized areas where protected areas are already highly confined in the surrounding urban matrix, the expansion of the effect zones further dissects and internally fragments what are already essentially habitat 'islands' (Balantyne et al. 2014; Pickering and Norman 2017).

The expansion of effect zones occurs in all protected areas with widespread trails irrespective of the sizes of the protected areas. For small protected areas (~300 ha) with dense trail networks, an effect zone of several hundred meters on either side of the trails can encompass a substantial proportion of the protected areas (Reed et al. 2019). In this way, effect zones reduce the proportion of a protected area that is suitable for various wildlife species (Reed et al. 2019), and can result in no contiguous areas across a protected area free from recreation-related disturbance to wildlife (Dertien et al. 2018).

The higher the level of recreation in protected areas, the greater the potential there is for the effects of trails and their use to extend beyond habitat loss and individual-level effects (behavioral and physiological) on wildlife into population- and community-level effects, including depletion of floral and faunal populations, alteration of trophic and community structures, and reduction of biodiversity (CDFW 2015). If habitat is available, wildlife may move to areas farther from trails, areas beyond the effect zone, to avoid recreation-related disturbance (Reed et al. 2019). However, the greater the proportion of a protected area occupied by effect zones, the fewer options there are for wildlife to move to areas outside the effect zones.

Unauthorized trails and technical trail features

General.—The implications to wildlife conservation of the disturbance to wildlife from trail-related fragmentation and expansion of effect zones are particularly grave with respect to unauthorized trails and recreational activities. The creation and use of unauthorized trails and technical trail features (TTFs) are commonplace and present concerns about the sustainability of biological resources in protected areas worldwide (Marion and Wimpey 2007; Newsome and Davies 2009; Ballantyne et al. 2014; Havlick et al. 2016; Barros and Pickering 2017).[8] Though most unauthorized trails and TTFs are readily visible and accessible, they are not officially planned or designed, approved for construction, managed, or part of a formally designated trail network (Davies and Newsome 2009; Leung et al. 2011; Hennings 2017). All user groups tend to create and use unauthorized trails, and there are several motivations for doing so, such as wanting access to trails closer to home or to engage in off-trail activities (Hennings 2017).

Though other recreationists venture off of designated trails, mountain bikers increasingly create unauthorized trails as they seek more challenging, wider-ranging, or free-riding opportunities (Havlick et al. 2016), or want a shortcut to reach specific destinations or to connect existing trails (Davies and Newsome 2009). If a trail is not sited in a place where bikers want to go, the off-trailing that results eventually forms trails (Davies and Newsome 2009).

Unauthorized trails expand the negative effects of human recreation on the flora and fauna of any protected area (Dertien et al. 2018). Similar to the above-discussed problems associated with internal fragmentation, unauthorized trails and recreational activities can negate the ecological benefits of both well-planned designated trails/trail networks and of prohibitions on access and activity (e.g., avoidance of breeding areas and seasonal access restrictions). The proliferation of unauthorized trails is often more responsible for trail-based fragmentation than formally designated trails (Ballantyne et al. 2014).

8 TTFs are created on mountain biking trails to increase the challenge of the ride. Examples of TTFs are jumps, ditches, mounds, bridges, ramps, ladders, drop offs, see saws, and 'skinnies' (i.e., narrow features that can be traversed) (Davies and Newsome 2009; Pickering et al. 2010c; Quinn and Chernoff 2010; Ballantyne et al. 2014; Havlick et al. 2016; Hennings 2017; Pickering and Norman 2017).

Even where unauthorized trails occupy a relatively small proportion of a landscape, they can be quite detrimental if in vital habitat; sensitive species whose territories or home ranges include the affected area(s) may be prevented via displacement or loss of habitat connectivity from accessing limited and essential resources (Gutzwiller et al. 2017). Wildlife can be more disturbed by off-trail than on-trail recreationists. For example, Taylor and Knight (2003) compared how mule deer (*Odocoileus hemionus*) respond to hikers and bikers using designated trails and one randomly chosen off-trail route. The deer exhibited a 70% probability of flushing from on-trail recreationists within 100 m from designated trails, whereas they exhibited a 96% probability of flushing within 100 m of recreationists located off trails, and their probability of flushing did not drop to 70% until the distance from the recreationists reached 390 m.

Examples.—Examples of protected areas affected by unauthorized trails include: 19 Natural Community Conservation Plan/Habitat Conservation Plan (NCCP/HCP; see footnote #2) protected areas in San Diego County, California where unauthorized trails comprise a mean of 45% (range: 8–85%) of the 1,206 km of trails mapped (Reed et al. 2014); an 829-ha area of the endangered Tall Open Blackbutt Forest in southeast Queensland, Australia, where 57% (26.5 km) of the 46.1 km of recreational trails was unauthorized when mapped in 2013 (Ballantyne et al. 2014); and, a 237-ha protected area in Argentina where 94% of the 19 km of trails found was unauthorized, resulting in landscape-level fragmentation and loss of vegetation (Barros and Pickering 2017). Another example of a protected area affected by unauthorized trails is the 191-ha Carlsbad Highlands Ecological Reserve in San Diego County. Though mountain biking is prohibited in this reserve, in addition to the 4 km of legal hiking trails in the reserve are also 27.4 km of unauthorized mountain biking trails and TTFs (E. Pert, South Coast Region, Regional Manager, California Department of Fish and Wildlife [CDFW], personal communication, 2019; Figure 1). This ecological reserve, so designated in 2000, comprises a critical component of an NCCP/HCP protected area and supports coastal sage scrub (a sensitive plant community), grasslands, thread-leaved brodiaea (*Brodiaea filifolia*, listed as threatened and endangered under the Federal and California endangered species acts, respectively), and several sensitive wildlife species: the federally threatened coastal California gnatcatcher (*Polioptila californica*), sharp-shinned hawk (*Accipiter striatus*), golden eagle (*Aquila chrysaetos*), white-tailed kite (*Elanus leucurus*), turkey vulture (*Cathartes aura*), and grasshopper sparrow (*Ammodramus savannarum*).[9]

Managing unauthorized trail creation and use.—Managing the rapid proliferation of unauthorized mountain biking trails and TTFs and their use is challenging. Even if only a small proportion of bikers is involved, the resulting vandalism can have serious ecological consequences as is well reflected in the statement, "[g]enerally when you ask people to stay out of the area no matter what the reason is, 80-90% obey you, [b]ut if you get 10% who don't obey you, you haven't done any good" (Bill Andree, retired district wildlife manager of Colorado Parks and Wildlife; Peterson 2019).

In the aforementioned Carlsbad Highlands Ecological Reserve, enforcement and education are necessary to substantially reduce the illegal riding, but the bikers monitor

9 Of CDFW's 136 ecological reserves (ER) statewide, biking is allowed on eight. About ERs, Title 14, California Code of Regulations §630(a) states, "All ecological reserves are maintained for the primary purpose of developing a statewide program for protection of rare, threatened, or endangered native plants, wildlife, aquatic organisms, and specialized terrestrial or aquatic habitat types. Visitor uses are dependent upon the provisions of applicable laws and upon a determination by the [Fish and Game] commission that opening an area to such visitor use is compatible with the purposes of the property."

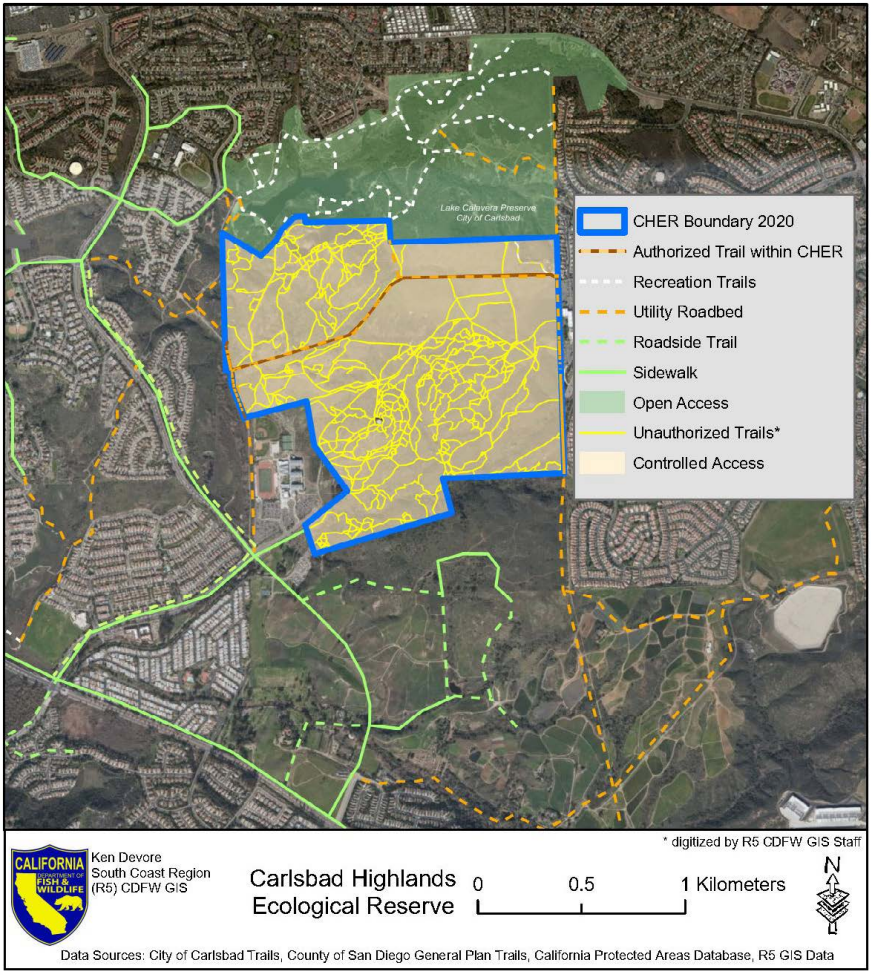

Figure 1. Carlsbad Highlands Ecological Reserve, Carlsbad, California. The yellow lines represent the unauthorized trails. Their associated effect zones occupy most, if not all of, the Ecological Reserve. (Credit: Ken Devore, South Coast Region (R5), GIS, CDFW 2017).

enforcement activity and recommence riding in the ecological reserve when enforcement officers leave (E. Pert, CDFW, personal communication, 2019). A similar protected area is the 350-ha Del Mar Mesa Preserve (Preserve) in the City of San Diego; the Preserve supports rare and endangered species such as Del Mar Manzanita (*Arctostaphylos glandulosa* ssp. *crassifolia)*, Orcutt's brodiaea (*Brodiaea orcutti)*, San Diego button celery (*Eryngium aristulatum* var. *parishii)*, San Diego mesa mint (*Pogogyne abramsii*), San Diego fairy shrimp (*Branchinecta sandiegonensis)*, and the California gnatcatcher, and was the subject of a study the City conducted to determine whether enforcement by CDFW Wildlife Officers (wardens) is an effective method to curb unauthorized trail uses (SANDAG 2015; Greer et al. 2017). Of the 32.22 km mapped trails on a 257-ha portion of this Preserve, 21.98 km are considered unauthorized (Reed et al. 2014). Prior to the study, City Park Rangers had

conducted regular educational efforts in the field an average of 3–4 times monthly over a 17–month period. Despite the Rangers' efforts, non-compliance became the social norm as more users followed expanding numbers of unauthorized trails (Greer et al. 2017). The subsequent period of the CDFW Wildlife Officers' enforcement comprised 810 hours during a 12-week period with an unpredictable schedule. Prior to enforcement activities, the majority (78.7%) of the use within the study area was illegal, and over 85.5% of the illegal use was mountain biking. Illegal mountain biking decreased quickly during the enforcement period by 66.0% over the study period and stayed low during the 43-day post-enforcement period, while legal mountain biking remained the same. Other illegal use also decreased significantly, while other legal uses doubled (Greer et al. 2017). Greer et al. (2017) cite decades of research indicating that a combination of soft (i.e., education) and hard (e.g., warnings, citations, arrests, confiscation of bikes) enforcement is the most effective approach to promoting compliance. They assert that education becomes less effective in areas with chronic unauthorized trail creation and use.

Overall conclusions from Greer et al.'s (2017) study follow: (1) soft enforcement aimed at public education and redirecting social norms was not sufficient to curb unauthorized trail use in the Preserve; (2) open space enforcement by CDFW Wildlife Officers was determined to be effective in reducing unauthorized use in the Preserve; (3) the threat of sanctions (hard enforcement) has a more general utility and effectiveness in curbing non-compliant behavior than outreach to promote "awareness-of-consequence" of user actions (soft enforcement). The authors also concluded that social media has great potential to engage and educate the public on environmental issues, and that its use in combination with community policing can be a powerful tool to: redirect user attitude and subsequent behavior through peer-to-peer education about environmental impacts; answer questions regarding authorized uses; and, warn users of potential sanctions for non-compliance. They recommend the implementation of a social media component prior to and during enforcement efforts to help educate recreationists and reduce misinformation and recreationists' distrust of managers and enforcement personnel (Greer et al. 2017).

Paucity of information available.—Despite the global proliferation and use of unauthorized trails and TTFs and their far-reaching effects on wildlife in protected areas, there is a paucity of information of any depth available on such effects. The impacts of unauthorized trails and TTFs have been rarely documented (Marion and Wimpey 2007; Davies and Newsome 2009). A comprehensive literature search prior to 2010 produced only eight studies documenting the effects of unauthorized trails (Pickering et al. 2010c). Since then, additional studies have assessed the effects on vegetation from unauthorized trails, with little elucidation about their effects on wildlife. The proliferation, use, and wildlife-related effects of unauthorized trails remain understudied and insufficiently addressed. For protected areas where the creation and use of unauthorized trails and TTFs are prevalent, it is infeasible to fully assess the recreation-related effects on wildlife without including these activities and their effects. Yet, these effects have a great potential to impair the ability of protected areas to meet their conservation objectives.

Disturbance thresholds

Disturbance thresholds are predetermined levels of various measurable indicators above or below (depending on the indicator) which wildlife is disturbed (Hennings 2017).

These thresholds may be used to establish management measures such as minimum widths of spatial buffers between recreational trails and wildlife. Exceedance of a threshold may trigger the implementation of further management measures (Hennings 2017). Examples of disturbance thresholds are distance between people and wildlife or between trails and nesting sites (i.e., the distance within which wildlife species avoid people or trails), density of active trails above which wildlife alters its use of habitat, number of recreationists per day over which wildlife abundance decreases, duration of recreation, and number of recreational events per unit time (Hennings 2017; Dertien et al. 2018).

Thresholds should be set at levels equal to or more protective of predetermined levels of disturbance, and should be responsive to trends in changing conditions as identified by monitoring (Hennings 2017). Data from studies of recreational activities can be used to estimate quantitative thresholds of disturbance to wildlife (Dertien et al. 2018); however, determining these thresholds requires very specific empirical data (Rodríguez-Prieto et al. 2014).

While determining and using disturbance thresholds would be ideal for managers to optimize management decisions (Rodríguez-Prieto et al. 2014), they are difficult to determine for broad application. For example, thresholds established for distance to trail are not necessarily adequately protective of the focal species under all conditions in which they occur; a general rule of minimum thresholds for distance to trail cannot be established for some species, as individual variability within species can be high and can differ among populations, types of topography, and frequencies and types of human intrusion (González et al. 2006). As a result, the literature about recreation-related disturbance to wildlife provides limited information about quantitative thresholds for distance to trail (Dertien et al. 2018). Though their sample sizes (i.e., number of articles reviewed with such information) are accordingly small, Dertien et al. (2018) found the following examples of such thresholds: wading birds and passerines were generally affected at distances less than 100 m; larger-bodied species such as hawks and eagles had threshold effect distances greater than 400 m; small rodent species avoided areas within 50-100 m of trails or people; and some carnivores and ungulates had minimum effect distances up to 350-1000 m from trails and people.

As another example of a spatial buffer, Dertien et al. (2018) recommend a 200-m minimum buffer for ungulates; however, this would be insufficient for the circumstances of Taylor and Knight's (2003) study in which they found that mule deer showed a 96% probability of flushing within 100 m of recreationists located off trails, and the probability of their flushing did not drop to 70% until perpendicular distance reached 390 m. Two additional factors that influence the determination of spatial buffers are the density of the trail networks and the above-discussed effect zones. The smaller a protected area is and the denser its trail networks are, the greater the proportion of the protected area is occupied by effect zones, and the less likely it is that spatial buffers will protect the focal species from recreational disturbance (Wilcove et al. 1986; Ballantyne et al. 2014).

Land managers should consider both trail density and the level of human recreation before deciding on disturbance thresholds, since thresholds that work at lower levels of human activity may be ineffective when activity levels increase (D'Acunto et al. 2018). D'Acunto et al. (2018) simulated the success of trail closure strategies on reducing disturbance from Off Road Vehicles and pedestrians to nesting golden eagles during laying and incubation, focusing on eagle flushing behavior from the nest and alteration of foraging flight. They found that, for current levels of human recreation, the restrictive buffer (i.e. all trails closed

within the buffer) was best at reducing flushing of incubating eagles, while closing all but the popular trails was best for foraging eagles. When the simulated human recreation was increased, trail density was the main factor influencing eagle flushing frequency.

Hennings (2017) reports the following thresholds for levels of human recreation (i.e., number of users) from four studies: for guanacos (*Lama guanicoe*), about 250 visitors per day, above which the number of birds observed declined; for sanderlings (*Calidris alba*), 20 visitors per day; for songbirds, eight out of 13 species showed thresholds ranging from 8-37 visitors per ha; and, for Mexican spotted owls (*Strix occidentalis lucida*), around 50 hikers per day. Regardless of any threshold effects, the majority of the research indicates that more visitors will generally cause more wildlife effects (Hennings 2017). However, since recreational impacts vary nonlinearly with use in a variety of ecosystems, a small number of visitors can have a disproportionate impact on sensitive species (Reed and Merenlender 2008).

Other aspects of recreation ecology to consider

Interpretation of observed behavioral responses.—It is possible to misconstrue the reasons for and implications of observed responses by wildlife to recreational activity. Traditionally and intuitively, species or individuals showing strong negative responses (e.g., readily flee or avoid) to human disturbance are those assumed to most need protection from disturbance. However, species with little suitable habitat available nearby cannot show marked avoidance of disturbance even if the fitness costs of the disturbance are high (e.g., reduction of survival or reproductive success; Gill et al. 2001). Conversely, species with many nearby alternative sites to move to are likely to move away from disturbance even if the fitness costs of the disturbance are low (Gill et al. 2001). It should not be assumed that the most responsive animals are the most vulnerable (Beale and Monaghan 2004). For example, in a controlled study of the behavioral responses of a shorebird (ruddy turnstone, *Arenia interpres*) to human disturbance (an approaching observer), Beale and Monaghan (2004) found that birds in better condition (i.e., supplemented with food) had longer flight initiation distances (i.e., flushed sooner) from the disturbance and searched for predators more frequently than control birds (i.e., not supplemented with food).[10] That is, birds responding most were actually the least likely to suffer any fitness consequences associated with the human presence; this is opposite from the response generally expected when behavior is used as an index of disturbance effects. Birds that had the most to lose by flushing, or otherwise changing their behavior in a manner that reduced feeding time, showed the least behavioral response; this could be interpreted incorrectly as meaning that these birds were not disturbed. Gill et al. (2001) assert that the absence of an obvious behavioral response does not rule out a population-level effect. In the same vein, it may be that species occurring in protected areas that are remnant fragments within urban landscapes are forced to utilize all components of the fragments, irrespective of their land-use intensity and land cover. This may occur if animals have nowhere else to go, and may be an explanation for instances when total relative abundance of birds is greater in urban and suburban reserves than in exurban reserves (Markovchick-Nicholls et al. 2008).

In addition to the reasons Gill et al. (2001) provide for an absence of detected effects, other possible reasons for finding no recreation-related effects include that there

10 Flight initiation distance is the distance from an approaching threat (e.g., recreationist) at which an animal begins to move away to escape from the threat.

may be a negative effect but it is not detected due to methodological issues. For example, the response variable examined (e.g., behavior versus physiology) and/or the number of replicates used compared to the amount of variation in the traits measured may not reveal the actual response of the species studied or the associated longer-term population-level effects (Steven et al. 2011). Furthermore, some studies may not include sufficiently high levels of human activity to detect responses from species that can tolerate lower levels of disturbance (Reed et al. 2019).

Threatened, endangered, and sensitive species.—Current research of recreation-related effects on wildlife does not include many species of urgent conservation concern (Larson et al. 2016). As many rare and isolated species tend to be specialists, anthropogenic activities could have a greater detrimental effect on the distribution, breeding success, and survival of individuals of these species (Beale and Monaghan 2004b; Bennett et al. 2013) than found in studies involving less sensitive species. Studies do not always reveal the strongest effects because the most disturbance-sensitive species are naturally rare in number or are already gone from disturbed sites (Hennings 2017). While recreation may not be the primary reason for the sensitive status of such species, it is a threat worth understanding for types of recreation that occur in the protected areas designated to conserve them (Larson et al. 2016).

Magnitude and duration of wildlife responses to recreation.— It is known that the nature (e.g., behavioral, physiological), magnitude, and duration of recreation-related disturbance to wildlife depend on a variety of factors, including, but not limited to, frequency and type of recreation, distribution of recreational use, season(s) of use, and environmental conditions (Marzano and Dandy 2012). Evaluating the effectiveness of measures to manage recreation can be complicated by the intensity of recreational use of a protected area because levels of use influence the magnitude of recreation-related effects on wildlife (Reed and Merenlender 2011). But studies do not always quantify the levels of recreational uses. Likewise, research seldom provides insight to the duration of wildlife species' response (e.g., nest abandonment, interruption of foraging/hunting, breeding, fleeing) to human disturbance (Marzano and Dandy 2012; Burger 2012; Larsen et al. 2016) or degree of response (e.g., how far wildlife moves away from human disturbance at a greater energetic cost and resulting in less availability of habitat). The same is true for the spatial scale at which wildlife response occurs (Burger 2012).

Generalized comparisons of effects among types of recreation.—It is clear from the literature that recreation in protected areas, particularly in more urbanized areas, can negatively affect wildlife (Larsen et al. 2016). However, it is difficult to make defensible generalized comparisons of the effects on wildlife among different types of recreation, partly because of the diversity of recreational activities, study methodologies, and observed responses (Monz et al. 2013). A comparison of results among similar studies indicates that sweeping conclusions about the effects of urbanization and human activity on wildlife need to be made with caution and are likely to be species-specific (Markovchick-Nicholls et al. 2008). For example, applying this caution to one species, the U.S. Fish and Wildlife Service (2000) concludes that attempts to ascribe relative importance, distinguish among, or generalize the effects of different human activities on bighorn sheep (*Ovis canadensis*) behavior are not supportable, given the range of potential reactions reported in the literature and the different variables impinging on given situations. Therefore, generalized comparisons of the effects on wildlife among different types of recreation are ill advised. The differences among types of recreation in their effects on wildlife are less important than the negative association for wildlife of human presence, irrespective of type of recreation (Patten and Burger 2018).

Despite the difficulty of making well-founded comparisons of the effects on wildlife among different types of recreation, comparisons are made. Among the types of recreation examined in the literature, the ecological effects of hiking and biking are most often compared. For studies done in the United States, this reflects the 22% increase to 8.3 million from 2006 to 2015 in mountain bikers, and the 24% increase to 37.2 million hikers during the same time period (Hennings 2017). And, notwithstanding the foregoing caveat about generalized comparisons, Hennings (2017) underscores that photographers, people with small children, bird watchers, and people engaging in loud conversations may be especially detrimental to bird communities because they are unpredictable and generally alarming. Photographers and wildlife watchers tend to stop, look directly at wildlife, and even follow them around, triggering stronger antipredator responses than people who simply pass by; photographers also tend to seek out rare species and look for nests. Also, curious, excited children tend to run around and shout in an unpredictable fashion (Marzano and Dandy 2012; Hennings 2017).

An absence of differences among effects.—The absence of differences among recreational activities' effects on wildlife does not equate to no effects. There can be similar levels of both benign or significant effects. For instance, in a study of bison (*Bison bison*) and pronghorn (*Antilocapra americana*), the authors found little difference in wildlife response (i.e., alert distance, flight initiation distance, or distance moved)[11] to hikers versus mountain bikers, but both species exhibited a 70% probability of flushing when within 100 m from trails with recreationists present (Taylor and Knight 2003).

Cumulative and synergistic negative effects.— The negative effects of recreation on wildlife compound, and may also act synergistically with, those from other influences (Larson et al. 2016; Reed et al. 2019). The cumulative negative effects of all anthropogenic influences on wildlife complicate efforts to minimize the effects and assess their population-level consequences (Pirotta et al. 2018). However, recreation ecology studies typically do not factor in other anthropogenic influences to which wildlife in protected areas are exposed (Pickering et al. 2010c; Erb et al. 2012; Messenger et al. 2014; Reed et al. 2019). Other anthropogenic influences include climate change and its associated effects on natural disasters; fires and other natural or human-caused disasters; consumptive recreation; non-recreational human activity such as habitat loss or alteration, the associated lack of connectivity, and the resulting loss of genetic diversity; poor air and/or water quality; invasive species; roads; vehicles; artificial light; prey declines; reverse zoonoses; drones; and noise (e.g., from vehicles, planes, ships, and boats). Recreation-related cumulative effects may be important if, for instance, the densities of different types of recreationists influence predator use of sites more than does the density of any one type of recreationist alone (Gutzwiller et al. 2017).

Wildlife habituation to human activity.—Habituation is a form of tolerance in which, as the result of a lack of negative consequences, there is a waning of response to a repeated, neutral stimulus (Whittaker and Knight 1998; Pauli et al. 2017). Habituation allows wildlife to use their energy for normal fitness-enhancing behaviors such as resting, foraging, and mating instead of fleeing when confronted with human activities that result in neutral outcomes (Whittaker and Knight 1998; George and Crooks 2006; Reilly et al. 2017). Habituation is

11 Alert distance is the distance from a stimulus at which an animal initiates vigilance behavior (Guay et al. 2016 in Reed et al. 2019); more specifically in this context, it is the distance between a recreationist and an animal when the animal first becomes visibly alert to the recreationist. Distance moved is the distance an animal travels from its initial position until it stops (Taylor and Knight 2003).

an apt description for crows (*Corvus* spp.) ignoring a scarecrow, or a red fox ignoring the human activity in a suburban area (Whittaker and Knight 1998). Citing several authors' work, Martínez-Abraín et al. (2008) identify level and frequency of disturbance, species, location, size and diet of species, and age of individual animals as factors that affect the degree of wildlife habituation to human disturbance.

The ability to habituate to predictable and recurrent human use of recreational trails may be an important behavioral adaptation for wildlife (González et al. 2006; Martínez-Abraín et al. 2008). However, habituated urban wildlife might be less likely to avoid contact with humans, which may increase the probability of human-wildlife conflicts and of attraction to anthropogenic food sources; both circumstances are considered problematic in many urban areas (Whittaker and Knight 1998; George and Crooks 2006). Wildlife habituation to humans may also increase wildlife aggression toward humans, or render wildlife more vulnerable to predators, hunters, poaching, or roadkill (Whittaker and Knight 1998; George and Crooks 2006; Marzano and Dandy 2012). Habituation of adult individuals may be associated with negative consequences for their offspring since habituation of adult animals does not translate to immediate habituation of juveniles (Reilly et al. 2017).

True habituation is not easily measured, and what appears to be habituation is often not (Hennings 2017). Apparent habituation is not a true measure of whether people are disturbing wildlife (Hennings 2017). Wildlife can experience significant stress without fleeing, and when this is misconstrued as habituation, disturbance effects on wildlife are underestimated (Hennings 2017). Care must be taken to avoid attributing a lack of observable response by wildlife to human presence as habituation (Beale and Monaghan 2004). Wildlife that seem not to avoid recreational disturbance may experience stress or be unable to leave a site if, for example, there is no suitable habitat nearby (Gill et al. 2001; Beale and Monaghan 2004; Markovchick-Nicholls et al. 2008).

While habituation to human disturbance could result in development of tolerance within a population (Pauli et al. 2017), Bötsch et al. (2018) infer from their findings on the recreation-related disturbance to birds in forests where recreation has occurred for decades that habituation to humans has not outweighed the effects of the disturbance. A long-lived species with low recruitment, such as the golden eagle, may be unable to experience individual learning or population-level evolutionary adaptation at a rate sufficient to compensate for a rapidly shifting anthropogenic landscape (Pauli et al. 2017).[12]

In a study subjecting captive female elk to four types of recreational disturbances (all-terrain vehicles riding, mountain biking, hiking, and horseback riding) over a two-year period, the elk showed no evidence of habituation to mountain biking. Similarly, elk travel time in response to hiking was generally above that of control periods, suggesting elk also did not habituate to hiking disturbance (Naylor et al. 2009).

In a study of how bison, mule deer, and pronghorn responded to hikers and bikers on designated recreational trails, Taylor and Knight (2003) found little evidence of habituation to recreationists among the species at the time of the study (summers of two consecutive years). In fact, the pronghorn at the study site did not habituate to largely predictable recreational use over a three-year period following the opening of trails at the site, and used areas that were significantly farther from trails than they had prior to the start of recreational use.

12 Evolutionary adaptation is the hereditary alteration or adjustment in structure or habits, the process by which a species or individual improves its ability to survive and pass on its genes in relationship to the environment (Ha and Campion 2019); unlike habituation, evolutionary adaptation does not result from learning during an individual's lifetime.

Hennings (2017) asserts that wildlife do not appear to habituate to the presence of dogs; impacts potentially linger after dogs are gone because the scent of dogs repels wildlife. It may be too that wildlife do not habituate to dogs (particularly off-leash dogs) because wildlife perceive dogs as predators and because they are unpredictable (Hennings 2016). Dog-specific disturbance has been studied for birds, with no evidence of habituation even with leashed dogs and even where dog-walking was frequent; the disturbance was much weaker for people without dogs (Hennings 2016).

The challenge of research.—Recreation ecology, similar to other fields of ecology, faces challenges in conducting statistically valid research (Quinn and Chernoff 2010). The degree to which and how the biotic and abiotic resources present in any one location respond directly or indirectly to recreational activities depends on many variables, some of which may be confounding (Figure 2, Table 1). Measuring the effects of human activity on wildlife is difficult because of the variability in the underlying spatial, diurnal, seasonal, and even the type of, indices being measured (Burger 2012). Recreation-related effects on wildlife vary among species (Larson et al. 2016) as different wildlife species respond differentially to visual, auditory, olfactory, and tactile stimuli (Hennings 2017). Wildlife responses to recreationists are likely influenced by a suite of variables that may differ in each field setting (Steidl and Anthony 1996; Taylor and Knight 2003), including level of human presence/activity that evokes a response as well as feedbacks and interactions with other factors (e.g., edge effects, availability of cover, exposure to disturbance, or time since fire; Patten and Burger 2018). Study methodology (i.e., design, sampling, data collection, and data analysis) itself encompasses many variables that dictate how other variables will influence the study outcomes. Even if methodology is consistent between/among two or more studies, other variables can result in different study results (Taylor and Knight 2003). Methodological issues may limit the inferences that can be made from the results (Pickering et al. 2010c).

Study design and statistical analyses can utilize methods to control for the effects of confounding variables (e.g., by using covariates). Statistical analyses can be used to examine alternative use-impact or use-response relationships between recreational activity and wildlife responses to assess the effects of recreational activity relative to other known drivers (e.g., habitat fragmentation, invasive species) of species occupancy, distribution, physiology, reproduction and survival (Monz et al. 2013; Reed et al. 2014).

Differences among study results.—Differences among studies' results can be due more to differences in variables not accounted for (e.g., space, diet, competition; Markovchick-Nicholls et al. 2008), study design, and/or analytical methodologies than to actual differences among species' responses to recreational disturbance. As to methodology, for instance, some studies may not include sufficiently high levels of human activity to detect responses from species that can tolerate lower levels of disturbance (Reed et al. 2019).

Reilly et al.'s (2017) study using camera trap data to quantify how hiking, mountain biking, horseback riding, and dog-walking affect habitat use/occupancy and diel shifts in activity patterns of ten mammalian species is illustrative for this discussion because some of its results differ markedly from those of other studies. For example, the authors found no negative association between recreation and habitat use by bobcats (*Lynx rufus*) and coyotes (*Canis latrans*), whereas Reed and Merenlender (2008) documented (in the same study area as Reilly et al.) densities of these two species more than five times lower in protected areas that permitted recreation versus those that did not. Dertien et al. (2018) identify differences in the following aspects of the two studies: field study methods, statistical analyses,

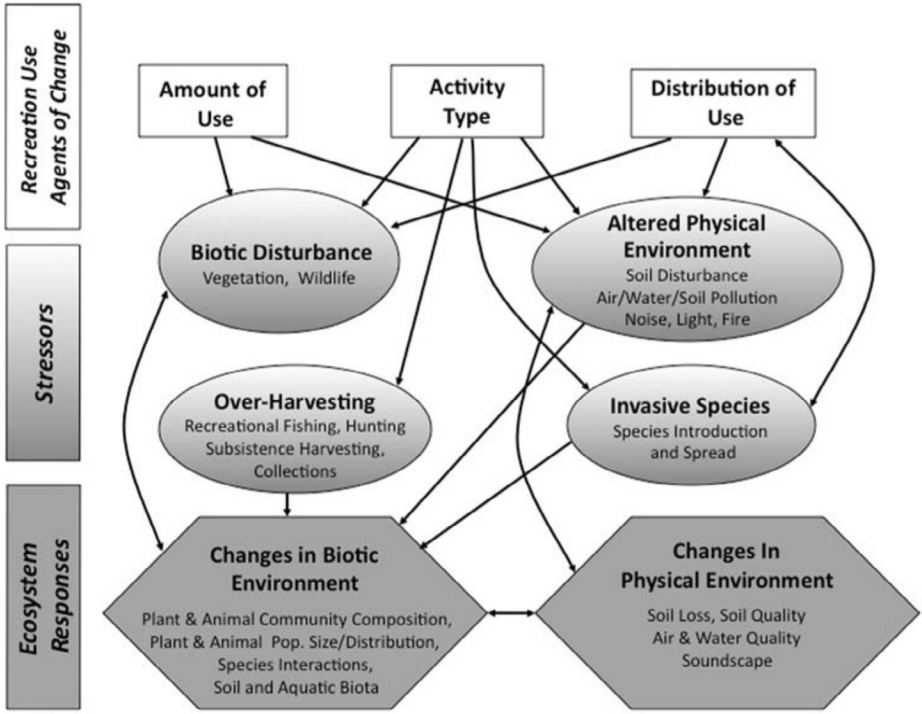

Figure 2. A conceptual model of ecological effects of outdoor recreation (Credit: Monz et al. 2010).

and research design – namely, types of study sites selected, treatment of data sources as replicates or independent of one another, and duration of data collection (one versus three years). These differences may have contributed to the greater variability observed in Reilly et al.'s (2017) study compared to Reed and Merenlender (2008).

Strong variability in other factors that are well known to influence mammalian distributions (e.g., habitat type, human development, or seasonal effects) make it difficult to conclude whether the potential effects of recreation on the target species were truly absent or simply undetected (Dertien et al. 2018). In addition, studies that use abundance, relative abundance, or species richness generally observe stronger effects of recreation than do studies such as Reilly et al.'s (2017) that use occupancy as a response variable (or occupancy interpreted as habitat use; Reed et al. 2019).

Reilly et al. (2017) acknowledge that: species vary widely in their responses to human activities; recreation-related effects on mammalian species that are rare or declining may be greater than on those that are more common or widely distributed; and birds, reptiles, amphibians, and small mammals may respond differently than the large and medium-sized mammals they studied. Finally, in contrasting their results with those of George and Crooks (2006), Reilly et al. do not acknowledge Gill et al.'s (2001) assertion that proximity to other suitable habitat influences how wildlife will respond to human disturbance; George and Crooks (2006) not only acknowledge but give credence to Gill et al.'s work.

Population-level effects

The foregoing discussion reveals many complexities of recreation ecology and provides a sense of why the population-level effects of human disturbance to wildlife are still poorly known (Burger 2012; Hennings 2017). Parameters used to measure population-level effects include population size, density, age structure, fecundity (birth rates), mortality (death rates), and sex ratio (Tarsi and Tuff 2012). Comprehensive assessments of the nonlethal effects on wildlife at the population level are rarely undertaken due to several constraints, including that robust assessment of these effects is challenging (Pirotta et al. 2018). Nonetheless, from a strictly conservation standpoint, human disturbance to wildlife is important only if

Table 1. Variables that influence the outcome of studies designed to assess the ecological effects of recreational activities. Each variable is mentioned in one or more of the cited articles (Taylor and Knight 2003; Beale and Monaghan 2004; Markovchick-Nicholls et al. 2007; Davis et al. 2010; Monz et al. 2010; Pickering 2010a; Quinn and Chernoff 2010; Burger 2012; D'Acunto 2018).

a. regional geophysical traits
b. size(s) of protected area(s) where research occurs
c. type(s) of vegetation present
d. area and density of vegetative cover
e. surrounding environment, including vegetation between the recreational activity and the target species
f. edaphic conditions (e.g., soil type, level of compaction, moisture, composition)
g. weather (temperature, precipitation, wind, shade, sun etc.)
h. timing (day / night / season)
i. time of day x location
j. design of trails (e.g., steepness of trails)
k. placement of trails (orientation to terrain - on flat, along a slope, across a slope)
l. direction of trails (ascending or descending)
m. spatial relationship between trails and target animals
n. trail density
o. wildlife present, target and non-target
p. total # of target wildlife individuals
q. spatial distribution of target wildlife
r. age classes and genders of target wildlife present (adult males/females, subadults, young of year)
s. reproductive status of target wildlife
t. fitness of target wildlife
u. predictability of recreational activity
v. degree of target animals' habituation to tested activities
w. duration of target animals' exposure
x. whether the target animals have the ability to retreat
y. type(s) of recreation
z. duration of recreational activity
aa. # of humans present (e.g., individuals or groups)
bb. # of human disturbances per day
cc. whether recreational activity is on or off an official trail
dd. recreationists' positions
ee. angle / trajectory of recreationists' approach to wildlife
ff. speed and style (e.g., 'aggressive') of recreationists' approach
gg. distance of recreational travel
hh. whether the recreationists apply best practices
ii. recreationists' behavior (e.g., talking or silent, continuous movement or stopping)
jj. encounter distance
kk. perpendicular distance
ll. encounter x perpendicular
mm. researcher bias
nn. study methodology (e.g., is recreationists' approach to wildlife direct or tangential, on or off trail; includes statistical analyses)

it affects survival or fecundity such that a population declines (Gill et al. 2001). Assessing and managing the nonlethal effects on wildlife populations has long been a goal of ecologists, land managers, and decision makers (Pirotta et al. 2018). The management of human activities that cause nonlethal effects on wildlife presents a fundamental ecological problem: how to understand the population-level consequences of changes in the behavior or physiology of individual animals that are caused by external stressors (Pirotta et al. 2018). Given the expansion of recreational activities that can disturb wildlife, quantitatively linking the effects of this disturbance to population dynamics is a major objective for modern conservation (Pirotta et al. 2018).

While behavioral responses, which are studied far more often than other types of responses (e.g., physiological; Larson et al. 2016), have the potential to affect survival or reproductive success, the actual fitness[13] costs of behavioral responses need to be quantified before the responses can be used as reliable estimates of population-level perturbations (Gill et al. 2001).

In most situations when statistical models are used to estimate or forecast the population-level effects of disturbance, selection of a model structure is likely to be driven by data availability (Pirotta et al. 2018). Collecting recreation data in conjunction with ongoing animal population monitoring efforts would be a valuable way to improve the understanding of the effects of human disturbance on demographic trends; and, studies that combine behavioral responses with physiological or demographic metrics would help calibrate the relationships between behavioral responses and population-level effects (Reed et al. 2019). Whichever models are used, uncertainty in the estimated population consequence can be reported as a distribution of potential outcomes, allowing the application of the precautionary principle if the results are used to make management decisions (Pirotta et al. 2018).[14] Application of the precautionary principle is warranted given that any simulation model simplifies reality (D'Acunto et al. 2018).

The dearth of conclusive evidence of recreation-related population-level effects in the literature does not mean that such effects are rare; logic dictates that, if the negative consequences of some observed behaviors or physiological changes in wildlife persist, negative population-level effects will eventually follow. For example, negative population-level effects on desert bighorn sheep (*Ovis canadensis nelsoni*) from recreational disturbance have been documented and are implicated in the bighorn sheep abandonment of habitat (and extirpation of the population) in the Pusch Ridge Wilderness in Arizona, USA (Longshore et al. 2013). And, recreation is one reason cited for the population of bighorn sheep in the Peninsular Ranges of California being listed in 1998 as endangered under the Federal Endangered Species Act (USFWS 2000).

The effects of hikers on elk (*Cervus elaphus*) provide another example of recreation-related population-level effects. Based on a two-year study of the response of female elk to the presence of back-country hikers during the calving season, Shively et al. (2005) recommended that some recreational closures be continued because, despite the evidence that elk reproduction can rebound from depressed levels when hikers are removed or reduced in

13 Fitness refers to reproductive success and reflects how well an organism is adapted to its environment (Hennings 2017).

14 The central tenet of the precautionary principle is that precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically. Generally, the four central components of the principle are: taking preventive action in the face of uncertainty; shifting the burden of proof to the proponents of an activity; exploring a wide range of alternatives to possibly harmful actions; and increasing public participation in decision making (Kriebel et al. 2001).

number, they could not determine if there is a threshold level of reproductive depression from which elk cannot recover. In fact, a 2019 article in *The Guardian* reported that the number of elk in the same herd Shively et al. (2005) studied had dropped precipitously since the early 2010s with the steady increase in recreation; what was once a herd of 1,000 head of elk, had dropped to 53 at last count in February of 2019 (Peterson 2019). The article explains that, for Bill Alldredge, one of the authors of the study, there is no other explanation than the increased levels of trail users in the area that supports this elk herd (Peterson 2019).

In a study to assess the effects of recreational activities on Iberian frogs (*Rana iberica*), an endemic species in decline and listed as vulnerable in the Spanish Red Data Book, Rodríguez-Prieto and Fernández-Juricic (2005) concluded that (1) the decrease in Iberian frog abundance with the proximity to recreational areas suggests that direct human disturbance affects this species at the population level, and (2) overall, the results suggest that direct human disturbance needs to be considered as a potential factor affecting amphibian populations with low tolerance for disturbance.

From the peer-reviewed recreation ecology literature, Steven et al. (2011) compiled 69 journal articles that describe the results of original research examining the effects of non-motorized nature-based recreation on birds. Among the articles were 33 that examined population-level avian responses (i.e., reproductive success including number of nests, number eggs laid, and number of chicks that hatched or fledged). Negative effects were reported in 85% of these 33 articles.

Patten et al.'s (2017) 10-year study of mammalian populations across the County of Orange Central and Coastal NCCP/HCP protected areas coincided with a marked increase of human activity and provides insight to potential population-level effects. Though the authors did not discern a decline in the populations studied, they did discern temporal and spatial shifts by wildlife due to human presence, and they suggested that the associated losses in prey populations are unsustainable in light of additional stressors these populations face, which range from continued loss of habitat to human disturbance in the protected areas. Furthermore, given the avoidance behavior and temporal shifts of the various mammalian species, any further increase in human disturbance may yet drive mammalian populations downward (Patten et al. 2017).

With regard to population-level effects of anthropogenic fragmentation, evolutionary adaptation to such fragmentation has received some attention. Even when adaptation to fragmentation occurs, it may not be enough to fully compensate for the environmental effects from fragmentation, and in some cases may even exacerbate them (Cheptou et al. 2017).

Distinguishing facets of mountain biking

Together with the extent of the above-discussed creation and use of unauthorized trails and TTFs by mountain bikers, the mass-marketing of the sport, and the very large numbers of mountain bikers (Burgin and Hardiman 2012), at least four facets of mountain biking distinguish it from other recreational activities such that it may be of potentially greater concern with respect to its effects on wildlife than yet accounted for in the literature. These facets are distance traveled, speed of travel, biking in the dark, and political lobbying and advocacy.

Distance traveled.—Bikers traveling faster obviously travel farther than hikers per unit time and could therefore disturb more wildlife than hikers per unit time (Taylor and Knight 2003; Burgin and Hardiman 2012); the same applies to bikers and equestrians when bikers travel faster than equestrians. Larson et al. (2016) reasoned that, since motorized activities

often cover larger spatial extents than non-motorized activities, it is possible that the effects of motorized activities have been underestimated. The same logic applies to the distances traveled by bikers and hikers. For valid comparisons among recreation-related ecological effects, the comparisons must account for distances traveled and the associated levels of disturbance to wildlife along the entire route traveled.

Speed of travel.—While recreation-related effects on wildlife are generally assumed to be indirect (Dertien et al. 2018), the speed at which mountain bikers travel, combined with their relatively quiet mode of travel, can result in direct disturbance to wildlife. A relatively fast moving, quiet mountain bike may approach an animal undetected until well within the animal's normal flight response zone. The result may be a severe startle response by the animal with significant consequences to the animal and/or the mountain biker (Quinn and Chernoff 2010). The sudden encounter is the most common situation associated with grizzly bear (*Ursus arctos horribillis*) inflicted injury (Quinn and Chernoff 2010). Biking-caused wildlife fatalities likely resulting because of bikers' speed occur with amphibians and reptiles that may be attracted to trails for thermoregulation and are thus exposed to collision with bikes' wheels (Burgin and Hardiman 2012); photo-documentation provides evidence of three such fatalities in CDFW's Del Mar Mesa Ecological Reserve in San Diego where a San Diego horned lizard (*Phrynosoma coronatum blainvillii*, a species of concern under CDFW and the U.S. Fish and Wildlife Service), three western toads (*Anaxyrus boreas*), and two Baja California treefrogs (*Pseudacris hypochondriaca*) were killed by mountain bikes (J. Price, CDFW, personal communication, 2019). The treefrogs appear to have been mating when run over—the photo documentation shows eggs spilling out of the female. Biking is prohibited in this ecological reserve, and two of the run-overs occurred on unauthorized trails (J. Price, CDFW, personal communication, 2019).

Though there are methods (e.g., bells attached to bikes) for mountain bikers to give warning of their approach to other trail users, and these can be effective for this purpose, these methods themselves can introduce additional disturbance to wildlife. And, such warning sounds are ineffective for wildlife whose hearing range does not detect them or who do not hear them soon enough to avoid a collision. Moreover, when recreationists are visible on approach to wildlife, the more threatening (e.g., faster, more direct) the recreationists appear to wildlife (as potential predators), the greater the flight initiation distance from the recreationists (Stankowich 2008). Fleeing from a perceived predator represents potentially needless expenditure of valuable energy.

Biking in the dark.—Mountain biking in the dark (i.e., night riding), which is on the rise in protected areas, can disrupt the natural balance between diurnal and nocturnal wildlife. Consequently, night riding poses a dual threat to wildlife that exhibit diel shifts toward night: night riding can compound the pressure such wildlife experience from daytime recreational activities by increasing encounters with competitors and even further reducing the time available for foraging and breeding (Reilly et al. 2017). Night riding can also startle naturally nocturnal wildlife and wildlife that has become increasingly nocturnal to avoid daytime recreationists and other anthropogenic disturbances. Generally, temporal shifts by wildlife involve disruptions to both the shifting wildlife and to the wildlife naturally active during the time frame the shifting wildlife move into. In this way, such shifts set both groups of wildlife up for conflict and competition, disrupt predator/prey relationships, reduce feeding/hunting time and success, and disrupt breeding and other activities (Gaynor 2018). Temporal shifts can also result in spatial shifts and thus potentially cause further ecological

disruptions. Thus, temporal shifts are disruptive not only to individuals, but also to communities, and ultimately, populations (Gaynor 2018).

Political lobbying and advocacy.—In part due to the markedly different motivation driving mountain bikers compared to other recreationists in protected areas, especially in the more extreme forms of mountain biking (Burgin and Hardiman 2012), the mountain biking community has come to wield significant lobbying and advocacy pressure throughout the United States. Networking among members if the mountain biking community has resulted in changes in land managers' decisions (Bergin and Hardiman 2012). In California, a newly formed mountain biking nonprofit aims to gain a voice at the capital with lawmakers to put trail access and trail development front and center (Formosa 2019). And, the community has much experience in planning trail networks, experience that is necessary to negotiate areas appropriate for mountain biking. In San Diego County, the local mountain biking coalition and the United States Forest Service (USFS) work in partnership to build trail networks on national forest lands; because the USFS does not have a budget for recreation, the only way trails will be built on national forest lands within the County is if the coalition pays the USFS for the agency's staff time, studies and environmental review, and project-processing needed to approve the trail networks (SDMBA 2017). While the USFS-biking coalition partnership may be similar to the accepted practice of an applicant (e.g., utility) paying a lead/permitting agency to dedicate personnel to the applicant's project(s) or a certain body of work, conflicts of interest are usually inherent in such collaborations. In addition, much of the USFS-biking coalition partnership's planning process occurs outside of public view, prior to the public knowing anything about it. It is notable that, while not all USFS lands are considered protected areas in the meaning of this paper, the wilderness areas the USFS manages are.[15]

Recommendations and conclusions

Conservation of habitats is critical to the perpetuation of viable populations of sensitive species. California is home to several types of protected areas whose primary or sole purpose is conservation of sensitive species. After conserving these protected areas, the next crucial step in biological conservation is managing how, where, and when humans use the land. However, there is rarely adequate management to control the allowed types and levels of recreation such that they are compatible with conservation, much less prevent the illegal recreation. The following discussion provides recommendations related to the major issues of recreation ecology addressed above. The implementation of most of these recommendations is considered management as the term is used in this paper (footnote #4), and land managers are familiar with most, if not all, of them. Still, it is hoped that the recommendations provide some new insights and even useful guidance for practical application in the management of dual-role protected areas, the wildlife they support, and the recreationists they serve. For simplicity, clarity, and brevity, several of the recommendations are in imperative sentences. For some of the aspects about recreation ecology discussed

15 The USFS manages approximately 33% of the acreage within the National Wilderness Preservation System (https://wilderness.net/learn-about-wilderness/agencies.php) and describes wilderness areas as places where nature "still calls the shots… They are final holdout refuges for a long list of rare, threatened, and endangered species, forced to the edges by modern development… They are places where law mandates above all else that *wildness* be retained for our current generation, and those who will follow" (https://www.fs.usda.gov/managing-land/wilderness).

above, there are no discrete recommendations.

Continual management is imperative.—Continual management (footnote #4) of recreation is imperative for dual-role protected areas to meet their conservation objectives. The chronic insufficiency of management resources for protected areas is of obvious concern. It is urgent that action be taken to address the chronically underfunded management of protected areas by securing perpetual fiscal support that is sufficient for the management needs in perpetuity; the perpetual fiscal support to be secured includes all costs for personnel and all program costs. The level of management must be commensurate with expanding levels of authorized and unauthorized non-consumptive recreation. Given the upward trajectory of recreational activities in protected areas, garnering broad support for securing the perpetual fiscal support requires a societal course change to a collective perspective of respecting and tending to other species in need of protection. Management that is effective for the biological resources would also improve the often cited economic, educational, and health benefits of protected areas.

Prevent further use and proliferation of unauthorized trails.—Prevent the creation and use of unauthorized trails in the first place. This approach would be far preferable to having to contend with the damage to the ecological resources and cultural ecosystem services (discussed below) from the creation and use of unauthorized trails in protected areas. Here, prevention requires continual management. Consider the lessons learned from the work Greer et al. (2017) describe, as summarized above. Where feasible, gain the trail user community's support for and involvement in proactive efforts to prevent vandalism.

Restore habitat to reverse internal fragmentation.—It is reasonable to assume that the disturbance to wildlife from internal fragmentation associated with authorized trails and from legal recreation on them, occurs at least as much from fragmentation associated with unauthorized trails and recreation on them. The internal trail-related fragmentation and expansion of the effect zone most negatively affects those species for which the fitness costs of disturbance are high but have little or no excess habitat to move to; these species are thus constrained to stay in disturbed areas and to suffer the costs in terms of reduced survival or reproductive success (Gill 2001). For these species, restoring the habitat lost to inappropriate trails (i.e., unauthorized trails, unnecessarily redundant designated trails, and trails to be decommissioned) is critical from the standpoint of the negative recreation-related population-level effects. Using restoration to minimize the effects of recreation within fragmented protected areas in urban areas might enable the fragments to better support the focal species (Reed et al. 2019).

Therefore, though the effects on wildlife from unauthorized trails and recreation, per se, have received comparatively little formal study, the precautionary principle (Kriebel et al. 2001; footnote #14) dictates that there seems no need for further study to justify prioritizing restoration of habitat lost to inappropriate trails. So, for levels or habitat loss and the associated internal fragmentation that meet some yet-to-be-established criteria, the restoration should occur. If there is competition for resources (budget/funding, personnel) between (1) research on recreation-related disturbance to wildlife and (2) restoration of habitat lost to inappropriate trails to stop the disturbance, the latter should take priority to reverse internal fragmentation.

To assess the effects of the restoration on the wildlife communities within the protected area, conduct biological surveys within a year prior to the restoration and three to five years after the completion of the groundwork and planting. For this assessment, valid pre-disturbance wildlife survey data collected prior to the loss of habitat within the footprint

of the trails that will be restored and associated effect zone will help. But if there are no pre-disturbance data for the protected area or a nearby undisturbed control area, care must be taken in the interpretation of the results of the survey conducted a year prior to the restoration (i.e., the first survey). This is because the results of the first survey will likely represent wildlife communities altered from the pre-disturbed condition (Hennings 2017). It may be that the level of fragmentation, recreation, and many other factors, have caused conditions in which there are no or very few individuals of the focal species (Hennings 2017). These are reasons to be conservative in estimating the recreation-related effects on wildlife in disturbed protected areas without pre-disturbance data; if wildlife have already vacated the disturbed site before the first survey is done, the results will underestimate disturbance effects on wildlife (Hennings 2017). Here, the purpose of the survey data is to aid in determining how the restoration affects the occurrence and/or density of species (depending on the survey methodology), all other factors being equal. The assessment must account for whether the restoration involves the cessation of recreational activities on and/or in the vicinity of the trails to be restored, especially if no other recreational activities begin elsewhere within the species' effect zone throughout the restoration period. If there is funding available and a desire to monitor human activity and wildlife within the restoration areas, deploy camera traps within the areas; camera traps are the most cost-effective method currently available to monitor wildlife activity (Burger 2012).

Minimally, include the following tasks in the restoration: track the actual and in-kind costs (personnel, capital costs, volunteer hours, etc.) for the entire process; map the inappropriate trails and constructed trail features (some use of aerial imagery may work, but on-the-ground mapping validation is essential; Dertien et. al. 2018); prioritize the order of their restoration; determine the best approach for restoring each trail (e.g., passive, active, or a combination); do the restoration itself;[16] and, monitor for several years. Finally, publicize the costs of the restoration to inform the public (F. Landis, California Native Plant Society, personal communication, 2017); for this, compare the costs of the restoration with the costs of the management (footnote #4) that would have been necessary to prevent the damage requiring the restoration. Reasons for documenting the costs include being able to provide to local and state elected officials comparisons of the costs of reactive and proactive approaches to management, and to inform the public about the costs of repairing ecological vandalism.

If possible and logistically advantageous, it would be prudent and economically beneficial to collaborate with recreationists to volunteer with the restoration. For example, this would be an opportunity to mobilize well-organized volunteer contingents of the mountain biking community that are dedicated to building trails. In fact, in some areas, the mountain biking community provides well-organized volunteer assistance in the designing, building, and/or maintenance of officially designated trails in and outside of protected areas. Such volunteer dedication to the restoration of unauthorized trails is sorely needed.

In addition to the biological benefits, another motivation for this habitat restoration in protected areas is its potential to improve the human experience in protected areas open to public access. California's State Wildlife Action Plan (CDFW 2015) and much of the literature about recreation-related ecological effects point to the economic, educational, and recreational/health benefits (i.e., cultural ecosystem services) of protected areas and the species they support. Regarding the human health benefits, the visible recreation-related

16 Here, restoration encompasses decompacting the soil, building back and stabilizing the damaged or destroyed terrain and soil, and restoring the affected native plant communities.

damage to the terrain requires consideration beyond its ecological effects—it also affects the level of benefit people enjoy while being in nature, as illustrated by a study examining the relationship between recreational impacts in protected areas and human mental/emotional states (Taff et al. 2019). The study's results demonstrate that, as visible recreation-related ecological impacts increased, sense of wellbeing and mental state decreased, especially in response to settings with unauthorized trails. Collectively, the results show that managing tourism in protected areas in a manner that reduces such impacts is essential to optimizing beneficial cultural ecosystem services related to human health and wellbeing (Taff et al. 2019). Also diminishing the human experience is the risk of injury when using unauthorized trails and TTFs (Davies and Newsome 2009), a risk that restoration would remove. The benefits of the cultural ecosystem services from habitat restoration may increase the potential to obtain funding for such restoration.

Use science-based disturbance thresholds and the precautionary approach.—Establish and use science-based disturbance thresholds to guide management, recognizing and accounting for the notion that the imprecision of thresholds applies to all species, even those for which quantitative thresholds for known sources of disturbances under specific conditions have been identified; thresholds may not adequately protect the target focal species under all conditions in which they occur. The determination of disturbance thresholds must consider the influence of trail-related expansion of effect zones, especially with respect to reductions in the proportions of protected areas that are suitable for wildlife.

To compensate for the imprecision of thresholds when using them to guide management, (1) apply a precautionary approach that adopts maximum values of quantitative disturbance thresholds observed for the taxa of concern, while excluding the extreme values of the thresholds (Dertien et al.'s 2018),[17] (2) take into account that the default position should be a precautionary approach that assumes a priori that the functional value of species' abundance is high (Baker et al. 2018), (3) employ continual proactive and adaptive management to protect wildlife from recreational disturbance,[18] and (4) restrict access if the management fails. The need for the precautionary approach stems from the gaps in knowledge about quantitative disturbance thresholds of recreation.

In trail and trail network planning, use the best available science.—When planning new or modifying existing trails and trail networks in protected areas, the best available science ought to guide policy and decision-making about the siting, design, and alignment of the trails, and about the types, levels, and timing of recreation under consideration. To protect the sensitive species, the policy and decision-making should factor in the capacity to manage the existing and planned trails and recreation in perpetuity. No matter how high the pressure from recreationists for more recreational trails and opportunities, it must be recognized that the majority of recreation-related effects on wildlife are negative. The implications of this necessitate thorough consideration as to whether recreational accommodations that are being considered (in conjunction with all other anthropogenic effects) are compatible with

17 The precautionary approach and the precautionary principle (footnote #14) have subtle differences between them, but consideration of the differences is beyond the scope of this paper.

18 Based on section 13.5 of the California Fish and Game Code (FGC) and the Natural Community Conservation Planning Act (i.e., section 2805 of the FGC), adaptive management generally means (1) improving management of biological resources over time by using new information gathered through monitoring, evaluation, and other credible sources as they become available, and (2) adjusting management strategies and practices accordingly to assist in meeting conservation and management goals (e.g., conservation of covered or focal species). Under adaptive management, program actions are viewed as tools for learning and to inform future actions. Adaptive management is a cornerstone of large-scale multiple species conservation (CDFW 2014).

the protected areas' conservation objectives. The planning should incorporate protective disturbance thresholds, allowing for adaptive modifications as needed. In situations where recreation has been assumed to meet the conditions of compatibility (e.g., as negotiated in NCCPs/HCPs), great care is needed to ensure the veracity of this assumption. The outcome of the planning process should be ecologically soundly designed, sited, and aligned trails and trail networks, with science-based restrictions on types, levels, and timing of recreation. In conjunction with new trail/trail network construction, restore the habitat lost to inappropriate trails within the area of the construction.

For future protected areas, plan separate recreational areas.—Planning for future protected areas and associated trail networks and recreational areas holds the greatest potential for successful collaboration among landowners, agencies, recreationists, and other stakeholders that allows for truly protective conditions for sensitive species with respect to recreation. Perhaps it is not too late for California to redirect the trajectory of the recreational juggernaut toward an inspirational conservation success story, where stakeholders come together in the planning process, and apply the prevailing science regarding recreation-related disturbance to wildlife to ensure the perpetuation of viable populations of wildlife in the very protected areas set aside primarily or solely for that purpose. Representatives of the recreation community should sit at the table when planning future protected areas and associated trail networks and recreational areas (Burgin and Hardiman 2012); if the outcome is acceptable to them, it may prevent or minimize the creation of unauthorized trails. For example, without a strong strategic approach to mountain biking that includes community engagement, the outcome will be further degradation of protected areas and, at the least, loss of individuals of wildlife, if not major threats to wildlife populations; it's likely that there will also be on-going conflict between mountain bikers and other recreationists and residents (Burgin and Hardiman 2013).

The limited availability of resources for management suggests that it may be more effective to allocate recreational uses and conservation targets among different sites, which will require a diverse suite of land conservation strategies (Reed and Merenlender 2008). At least until such time that there is management of recreation in protected areas commensurate with recreational pressure, planning for future protected areas should heed what has been commonly known for at least 60 years: if conservation of land occurs without enforcing quotas on visitors, then separate areas need to be provided to accommodate recreational activities elsewhere so that the protected land will not bear the burden of those activities (Wilson 2019). This sentiment applies far more today, principally to protected areas preserved primarily or solely for the perpetuation of sensitive species. While this approach is infeasible for many established protected areas (most protected areas in urban areas), going forward, this ought to be the paradigm of habitat and species conservation in areas of high recreational pressure.

Figure 3 depicts an idealized vision of conservation planning using this approach. For protected areas established pursuant to NCCPs/HCPs negotiated in urban settings within an already fragmented landscape, there is often limited latitude for separate areas for recreation; furthermore, sensitive species are typically distributed more evenly across the urbanized landscape than depicted in Figure 3. Nevertheless, it represents the fundamental approach of separating conservation areas from recreational areas. Even in constrained areas, if planning for recreational access occurs at the regional level, planners and land managers could ensure that protected area networks include some areas that are closed to recreation, thus

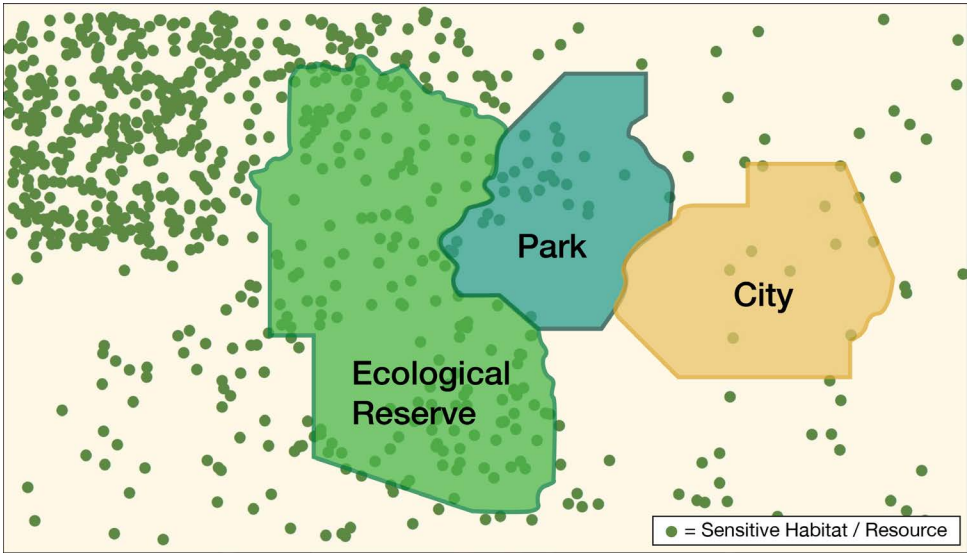

Figure 3. Effective planning for protected areas preserved primarily or solely for the perpetuation of viable populations of sensitive species: provide separate areas for conservation (e.g., ecological reserves) and recreational activities (i.e., parks). (Credit: Landscape Conservation Planning Program, CDFW 2020)

balancing the dual land uses of conservation and recreation at the scale of the protected area network instead of each individual protected area (Reed et al. 2019). Formally incorporating wildlife considerations into the trail planning process from the start is essential to reducing recreation-related disturbance to wildlife; if trail planning is well underway by the time wildlife is considered, it may be too late to gather sufficient wildlife information to inform the planning process (Hennings 2017).

A consideration often not made in conservation planning is the need to address the temporal aspect of human-wildlife interactions. For example, similar to seasonal restrictions, diurnal or nocturnal "temporal zoning" may be necessary to restrict certain human activities during times of the day when sensitive species are most active or when the likelihood of negative human-wildlife encounters is greatest (Gaynor 2018; Whittington 2019). The effectiveness of temporal closures likely depends on the amount and quality of habitat, and levels of human use and fragmentation, within the planned protected areas and in the surrounding landscape. Temporal closures may not benefit wildlife with diurnal activity patterns that differ from the timing of the temporal closures; so, full closures may be required to increase wildlife use in many situations (Whittington 2019). For situations when protected areas and recreational areas are separate but share a boundary, temporal zoning would also apply to the effect zone within the recreational area.

Conclusion.—The most sensible approach for species conservation may be to concentrate research and protection efforts on species whose populations are declining and for which human disturbance is implicated as a possible cause (Gill et al. 2001). The designation of ecological reserves and the conservation of habitat pursuant to NCCPs/HCPs are examples of processes that embody this approach. But, when recreation in such protected areas is not properly planned and adequately managed, their ecological viability and ability to meet their conservation objectives are jeopardized. Implementation of the recommendations provided

herein is necessary to ensure the focal species thrive.

Ultimately, for wildlife that avoids human activity, it is unlikely that dual-role protected areas are entirely sufficient or justifiable for meeting conservation objectives; limiting or prohibiting recreation in strategic circumstances and locations within protected areas is necessary to achieve conservation objectives (Bötsch et al. 2018; Dertien et al. 2018; Reed et al. 2019). Enforced closures of inappropriate trails in all protected areas and restoration of those trails would substantially decrease the trail-related disturbance to wildlife across the landscape; waiting until after wildlife detections or estimates of habitat use decrease is too late to implement these measures (Dertien et al. 2018). These approaches require perpetual management commensurate with expanding levels of authorized and unauthorized non-consumptive recreation in protected areas. Action is urgently needed to secure perpetual fiscal support for management sufficient to ensure the perpetuation of viable populations of sensitive species in protected areas.

ACKNOWLEDGMENTS

Sincere thanks to C. Beck (CDFW, retired), E. Pert (CDFW), H. Pert (CDFW), and B. Tippets (Southwest Wetlands Interpretive Association), each of whom provided valuable edits and constructive suggestions on this manuscript and a previous draft of it; their input resulted in substantial improvements.

LITERATURE CITED

Baker, A. D., and P. L. Leberg. 2018. Impacts of human recreation on carnivores in protected areas. PLoS ONE 13(4):e0195436.

Baker, D. J., S. T. Garnett, J. O'Connor, G. Ehmke, R. H. Clarke, J. C. G. Woinarski, and M. A. McGeoch. 2018. Conserving the abundance of nonthreatened species. Conservation Biology 33:319–328.

Ballantyne, M., O. Gudes, and C. M. Pickering. 2014. Recreational trails are an important cause of fragmentation in endangered urban forests: a case-study from Australia. Landscape and Urban Planning 130:112–124.

Barros, A., and C. M. Pickering. 2017. How networks of informal trails cause landscape level damage to vegetation. Environmental Management 60:57–68.

Beale, C. M., and P. Monaghan. 2004. Behavioural responses to human disturbance: a matter of choice? Animal Behaviour 68:1065–1069.

Beale, C. M., and P. Monaghan. 2004b. Human disturbance: people as predation-free predators? Journal of Applied Ecology 41:335–343.

Bennett, V. J., V. S. Quinn, and P. A. Zollner. 2013. Exploring the implications of recreational disturbance on an endangered butterfly using a novel modelling approach. Biodiversity and Conservation 22:1783–1798.

Bötsch, Y., Z. Tablado, D. Sheri, M. Kéry, R. F. Graf, and L. Jenni. 2018. Effect of recreational trails on forest birds: human presence matters. Frontiers in Ecology and Evolution 6:175.

Burger, J. C. 2012. An efficient monitoring framework and methodologies for adaptively managing human access on NCCP lands and other reserves in southern California. Final report to California Department of Fish and Wildlife for LAG #PO982014.

Burgin, S. and N. Hardiman. 2012. Is the evolving sport of mountain biking compatible with fauna conservation in national parks? Australian Zoologist 36:201–208.

CDFW (California Department of Fish and Wildlife). 2015. California State Wildlife Action Plan, 2015 Update: A Conservation Legacy for Californians. Edited by Armand G. Gonzales and Junko Hoshi, PhD. Prepared with assistance from Ascent Environmental, Inc., Sacramento, CA.

CDFW. 2016. SWAP's Consumption and Recreational Uses and Companion Plan.

CDFW. 2019. Slide from a presentation titled Balancing Conservation and Recreation - Trails on Conservation Lands. California Trails & Greenways Conference. April 25, 2019. Available from: https://www.parks.ca.gov/pages/1324/files/Balancing%20Conservation%20and%20Recreation%20-%20Trails%20on%20Conservation%20Lands.sm.pdf (May 2019)

Cheptou, P. O., A. L. Hargreaves, D. Bonte, and H. Jacquemyn. 2017. Adaptation to fragmentation: evolutionary dynamics driven by human influences. Philosophical Transactions of the Royal Society B 372: 20160037.

D'Acunto, L. E., R. J. Spaul, J. A. Heath, and P. A. Zollner. 2018. Simulating the success of trail closure strategies on reducing human disturbance to nesting Golden Eagles. The Condor 120:703–718.

Davies, C., and D. Newsome. 2009. Mountain bike activity in natural areas: impacts, assessment and implications for management – a case study from John Forrest National Park, Western Australia. CRC for Sustainable Tourism Pty, Australia.

Davis, C. A., D. M. Jr. Leslie, W. D. Walter, and A. Graber. 2010. Mountain biking trail use affects reproductive success of nesting golden-cheeked warblers. Wilson Journal of Ornithology 122(3):465–474.

Dertien, J.S., C. L. Larson, and S. E. Reed. 2018. Adaptive management strategy for science-based stewardship of recreation to maintain wildlife habitat connectivity. Wildlife Conservation Society, Americas Program, Bronx, NY, USA.

Erb, P. L., W. J. McShea, and R. P. Guralnick. 2012. Anthropogenic influences on macro-level mammal occupancy in the Appalachian Trail corridor. PLoS ONE 7(8): e42574.

Formosa, N. 2019. More trails for California mountain bikers? BIKE Magazine. December 22.

Gaynor, K.M., C. E. Hojnowski, N. H. Carter, and J. S. Brashares. 2018. The influence of human disturbance on wildlife nocturnality. Science 360:1232–1235.

George, S.L., and K. R. Crooks. 2006. Recreation and large mammal activity in an urban nature reserve. Biological Conservation 133.1 (2006):107–117.

Gill, J., K. Norris, and W. Sutherland. 2001. Why behavioral responses may not reflect the population consequences of human disturbance. Biological Conservation 97. 265–268.

González, L. M., B. E. Arroyo, A. Margalida, R. Sánchez, and J. Oria. 2006. Effect of human activities on the behaviour of breeding Spanish imperial eagles (*Aquila adalberti*): management implications for the conservation of a threatened species. Animal Conservation 9:85–93.

Greer, K., K. Day, and S. McCutcheon. 2017. Efficacy and perception of trail use enforcement in an urban natural reserve in San Diego, California. Journal of Outdoor Recreation and Tourism 18:56–64.

Gutzwiller, K. J., A. L. D'Antonio, and C. A. Monz. 2017. Wildland recreation disturbance: broad-scale spatial analysis and management. Frontiers in Ecology and the Environment 15(9):517–524.

Ha, J. C., and T. L. Campion. 2018. Dawn of the dog: Evolutionary theory and the origin of modern dogs (*Canis familiaris*). Pages 1–32 in Ha J. C., and T. L. Campion, editors. Dog Behavior: Modern Science and Our Canine Companions. Elsevier Science & Technology, San Diego, CA, USA.

Havlick, D. G., E. Billmeyer, T. Huber, B. Vogt, and K. Rodman. 2016. Informal trail creation: hiking, trail running, and mountain bicycling in shortgrass prairie. Journal of Sustainable Tourism.

Hennings, L. 2016. The impacts of dogs on wildlife and water quality: a literature review. Metro Parks and Nature, Portland, OR, USA. Included in Hennings 2017 as Appendix 1.

Hennings, L. 2017. Hiking, mountain biking and equestrian use in natural areas: A recreation ecology literature review. Metro Parks and Nature, Portland, OR.

Kriebel D., J. Tickner, P. Epstein, J. Lemons, R. Levins, E. L. Loechler, M. Quinn, R. Rudel, T. Schettler, and M. Stoto. 2001. The precautionary principle in environmental science. Environmental Health Perspectives 109:871–876

Larson, C. L., S. E. Reed, A. M. Merenlender, and K.R. Crooks. 2016. Effects of recreation on animals revealed as widespread through a global systematic review. PLoS ONE 11(12):e0167259.

Laurance, W. F., H. E. M. Nascimento, S. G. Laurance, A. Andrade, R. M. Ewers, K. E. Harms, R. C. Luizão, and J. E. Ribeiro. 2007. Habitat fragmentation, variable edge effects, and the landscape-divergence hypothesis. PLoS ONE 2(10):e1017.

Leung, Y. F., T. Newburger, M. Jones, B. Kuhn, and B. Woiderski. 2011. Developing a monitoring protocol for visitor-created informal trails in Yosemite National Park, USA. Environmental Management 47:93–106.

Longshore, K., C. Lowrey, and D. B. Thompson. 2013. Detecting short-term responses to weekend recreation activity: desert bighorn sheep avoidance of hiking trails. Wildlife Society Bulletin 37:698–706.

Marcot, B. G., and C. H. Flather. 2007. Species-level strategies for conserving rare or little-known species. Pages 125–164 in M. G. Raphael and R. Molina, editors. Conservation of rare or little-known species. Island Press, Washington, D.C., USA.

Marion, J. L., and J. Wimpey. 2007. Environmental impacts of mountain biking: Science review and best practices. Pages 94–111 in P. Webber, editor. Managing mountain biking. International Mountain Biking Association, Boulder, CO, USA.

Markovchick-Nicholls, L., H. M. Regan, D. H. Deutschman, A. Widyanata, B. Martin, L. Noreke, and T. A. Hunt. 2008. Relationships between human disturbance and wildlife land use in urban habitat fragments. Conservation Biology 22:99–109.

Martínez-Abraín, A., D. Oro, J. Jiménez, G. Stewart, and A. Pullin. 2008. What are the impacts of human recreational activity on the distribution, nest-occupancy rates and reproductive success of breeding raptors? Collaboration for Environmental Evidence review 07–003 (Systematic Review 27).

Marzano, M., and N. Dandy. 2012. Recreationist behaviour in forests and the disturbance to wildlife. Biodiversity and Conservation 21:2967–2986.

Messenger, A. M., A. N. Barnes, and G. C. Gray. 2014. Reverse Zoonotic Disease Trans-

mission (Zooanthroponosis): A systematic review of seldom-documented human biological threats to animals. PLoS ONE 9(2):e89055.

Monz, C. A., D. N. Cole, Y. F. Leung, and J. L. Marion. 2010. Sustaining visitor use in protected areas: Future opportunities in recreation ecology research based on the USA experience. Environmental Management 45:551–562.

Monz, C. A., C. M. Pickering, and W. L. Hadwen. 2013. Recent advances in recreation ecology and the implications of different relationships between recreation use and ecological impacts. Frontiers in Ecology and the Environment 11:441–46.

Naylor, L. M., M. J. Wisdom, and R. G. Anthony. 2009. Behavioral responses of North American elk to recreational activity. Journal of Wildlife Management 73:328–338.

Patten, M., and J. Burger. 2018. Reserves as double-edged sword: Avoidance behavior in an urban-adjacent wildland. Biological Conservation 18:233–239.

Patten, M., J. Burger, and M. Mitrovich. 2017. Assessing effectiveness of adaptive recreation management strategies and evaluation of core NCCP/HCP habitat areas. Final Report for California Department of Fish and Wildlife Local Assistance Grant #P1482109. 85 pp.

Pauli, B. P., R. J. Spaul, and J. A. Heath. 2017. Forecasting disturbance effects on wildlife: tolerance does not mitigate effects of increased recreation on wildlands. Animal Conservation 20:251–260.

Peterson, C. 2019. Americans' love of hiking has driven elk to the brink, scientists say. The Guardian. August 25.

Pickering, C. M. 2010a. Ten factors that affect severity of environmental impacts of visitors to protected areas. Ambio. 39(1):70–77

Pickering, C. M., J. G. Castely, W. Hill, and D. Newsome. 2010b. Environmental, safety and management issues of unauthorised trail technical features for mountain bicycling. Landscape and Urban Planning 97:58–67.

Pickering, C. M., W. H. Hill, D. Newsome, and Y. F. Leung. 2010c. Comparing hiking, mountain biking and horse riding impacts on vegetation and soils in Australia and the United States of America. Journal of Environmental Management 91:551–562.

Pickering, C. M., and P. Norman. 2017. Comparing impacts between formal and informal recreational trails. Journal of Environmental Management 193:270–279

Pirotta, E., C. G. Booth, D. P. Costa, E. Fleishman, S. D. Kraus, D. Lusseau, D. Moretti, L. F. New, R. S. Schick, L. K. Schwarz, S. E. Simmons, L. Thomas, P. L. Tyack, M.J. Weise, R. S. Wells, and J. Harwood. 2018. Understanding the population consequences of disturbance. Ecology and Evolution. 8:9934–9946. doi:10.1002/ece3.4458

Quinn, M., and G. Chernoff. 2010. Mountain Biking: a review of ecological effects. Tech. Calgary: Miistakis Institute. Print.

Reed, S. E., and A. M. Merenlender. 2008. Quiet, nonconsumptive recreation reduces protected area effectiveness. Conservation Letters 1:146–154.

Reed, S. E., and A. M. Merenlender. 2011. Effects of management of domestic dogs and recreation on carnivores in protected areas in Northern California. Conservation Biology 25:504–513.

Reed, S. E., C. L. Larson, and K. R. Crooks. 2019. Effects of human use of NCCP Reserves on reptile and mammal species in San Diego. Wildlife Conservation Soci-

ety Agreement No / LAG #: P1582100.

Reed, S. E., C. L. Larson, K. R. Crooks, and A. M. Merenlender. 2014. Wildlife response to human recreation on NCCP reserves in San Diego County. Wildlife Conservation Society Agreement No / LAG #: P1182112.

Reilly, M. L., M. W. Tobler, D. L. Sonderegger, and P. Beier. 2017. Spatial and temporal response of wildlife to recreational activities in the San Francisco Bay ecoregion. Biological Conservation 207:117–126.

Rodríguez-Prieto, I., and E. Fernández-Juricic. 2005. Effects of direct human disturbance on the endemic Iberian frog *Rana iberica* at individual and population levels. Biological Conservation 123:1–9.

Rodríguez-Prieto, I., V. J. Bennett, P. A. Zollner, M. Mycroft, M. List, and E. Fernández-Jurici. 2014. Simulating the responses of forest bird species to multi-use recreational trails. Landscape and Urban Planning 127:164–172.

SANDAG (San Diego Association of Governments). 2015. Del Mar Mesa Preserve enforcement project San Diego, CA.

San Diego Mountain Biking Association (SDMBA). 2017. October 23 Advocacy Meeting. Available from: https://www.facebook.com/SDMBA/videos/vb.71076071171/10155092539971172/?type=2&theater (June 2019).

Shively, K. J., A. W. Alldredge, and G. E. Phillips. 2005. Elk reproductive response to removal of calving season disturbance by humans. Journal of Wildlife Management 69:1073–1080.

Soulé, M. E., D. T. Bolger, A. C. Alberts, J. Wright, M. Sorice, and S. Hill. 1988. Reconstructed dynamics of rapid extinctions of chaparral-requiring birds in urban habitat islands. Conservation Biology 2:75–92.

Soulé, M. E., and R. F. Noss. 1998. Rewilding and biodiversity: complimentary goals of continental conservation. Wild Earth 8(3):19–28.

Stankowich, T. 2008. Ungulate flight responses to human disturbance: A review and meta-analysis. Biological Conservation 141:2159–2173.

Steidl, R. J., and R. G. Anthony. 1996. Responses of bald eagles to human activity during the summer in interior Alaska. Ecological Applications 6:482–491.

Steven, R., C. Pickering, and J. G. Castley. 2011. A review of the impacts of nature based recreation on birds. Journal of Environmental Management 92: 2287–2294.

Taff B. D., J. Benfield, Z. D. Miller, A. D'Antonio, and F. Schwartz. 2019. The role of tourism impacts on cultural ecosystem services environments 6:43.

Tarsi, K., and T. Tuff. 2012. Introduction to population demographics. Nature Education Knowledge **3:3.** Available from: https://www.nature.com/scitable/knowledge/library/introduction-to-population-demographics-83032908/ (December 2019).

Taylor, A. R., and R. L. Knight. 2003. Wildlife responses to recreation and associated visitor perceptions. Ecological Applications 13(4):951–963.U.S. Fish Wildlife Service. 2000. Recovery plan for bighorn sheep in the Peninsular Ranges, California. U.S. Fish and Wildlife Service, Portland, Oregon, USA. xv + 251 pp.

Vickers T.W., J. N. Sanchez, C. K. Johnson, S. A. Morrison, R. Botta, T. Smith, et al. 2015. Survival and mortality of pumas (*Puma concolor*) in a fragmented, urbanizing landscape. PLoS ONE 10(7):e0131490.

Whittaker, D., and R. L. Knight. 1998. Understanding wildlife responses to humans. Wildlife Society Bulletin 26:312–317.

Whittington, J., P. Low, and B. Hunt. 2019. Temporal road closures improve habitat quality

for wildlife. Scientific Reports 9:3772.

Wilcove D. S., C. H. McLellan, and A. P. Dobson. 1986. Habitat fragmentation in the temperate zone. Pages 237–256 in: M. E. Soulé, editor. Conservation Biology: the science of scarcity and diversity. Sinauer Associates, Inc. Sunderland, Massachusetts, USA.

Wilson, M. 2019. What do we owe our national parks? The Atlantic. July 4.

Zurita, G., G. Pe'er, G., M. I. Bellocq, and M. Hansbauer. 2012. Edge effects and their influence on habitat suitability calculations: A continuous approach applied to birds of the Atlantic forest. Journal of Applied Ecology 49:503–512.

INFORMATION FOR AUTHORS

The California Fish and Wildlife Journal (CFWJ) is a peer-reviewed, scientific journal focused on the biology, ecology, and conservation of the flora and fauna of California and surrounding areas, and the northeastern Pacific Ocean.

Submissions guidelines (PDF) for the Journal have been updated (July 2019).

The California Fish and Wildlife Journal accepts manuscripts in the following categories:

- Original research papers
- Research notes
- Review papers
- Book reviews
- Commentaries and Essays

Manuscripts must be submitted by e-mail following directions provided in the link: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=171113&inline. The journal standard for style is consistent with the Council of Science Editors (CSE) Style Manual. Instructions in the CFWJ guidelines supersede the CSE Style Manual where differences exist between formats. Please follow these formatting guidelines carefully. Manuscripts that do not conform to the guidelines will be returned for revision.

Authors of manuscripts that are accepted for publication will be invoiced for charges at the rate of $50 per printed page shortly after page proofs are distributed.* Authors should state acceptance of printing charges in their cover letters. The corresponding author will receive a PDF file of the publication without additional fees and may distribute copies without restriction.

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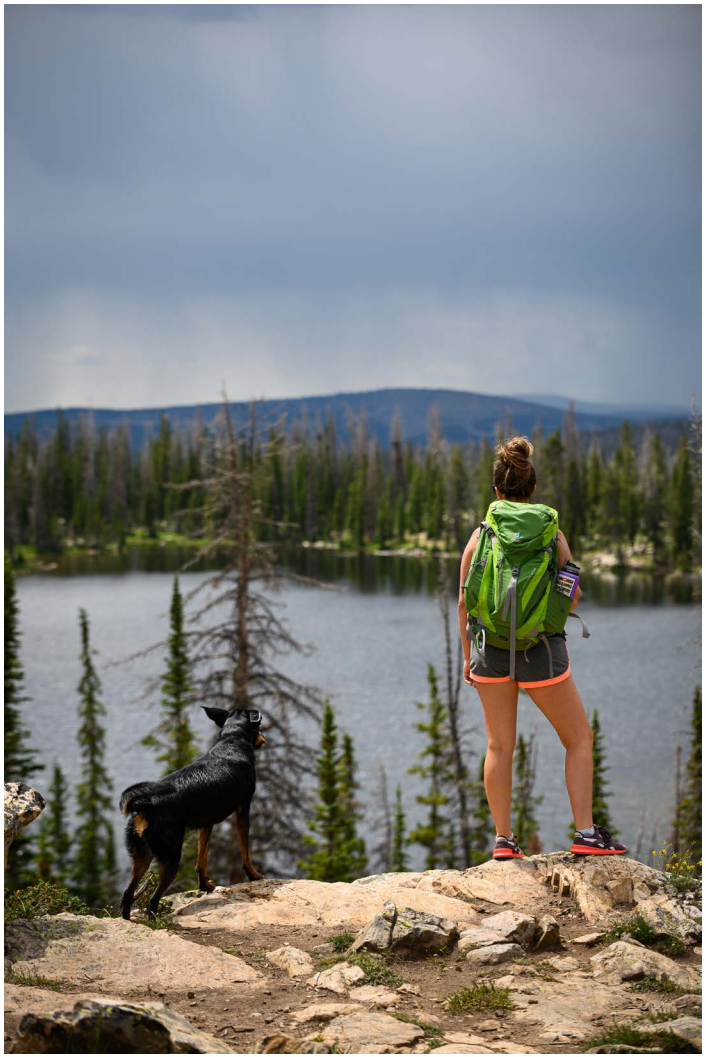

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San Diego County Archaeological Society, Inc.

Environmental Review Committee

5 April 2021

To: Ms. Lorrie Bradley
Department of Parks and Recreation
County of San Diego
5500 Overland Avenue, Suite 410
San Diego, California 92123

Subject: Notice of Preparation of a Draft Environmental Impact Report
Alpine County Park Project

Dear Ms. Bradley:

Thank you for the Notice of Preparation for the subject project, which we downloaded from the County's website.

We are pleased to note the inclusion of cultural resources in the list of subject areas to be addressed in the DEIR and look forward to reviewing it and its cultural resources technical report(s) during the upcoming public comment period.

SDCAS appreciates being included in the County's environmental review process for this project.

Sincerely,

James W. Royle, Jr., Chairperson
Environmental Review Committee

cc: SDCAS President
File

P.O. Box 81106 San Diego, CA 92138-1106 (858) 538-0935

From:	Ray Teran
To:	CEQA, CountyParks
Cc:	Ernest Pingleton
Subject:	Alpine County Park
Date:	Wednesday, March 10, 2021 11:22:36 AM

The Viejas Band of Kumeyaay Indians ("Viejas") has reviewed the proposed project and at this time we have determined that the project site has cultural significance or ties to Viejas. Cultural resources have been located within or adjacent to the APE-DE of the proposed project.

Viejas Band request that a Kumeyaay Cultural Monitor be on site for ground disturbing activities and to inform us of any new developments such as inadvertent discovery of cultural artifacts, cremation sites, or human remains.

If you wish to utilize Viejas cultural monitors, please call Ernest Pingleton at 619-655-0410 or email, epingleton@viejas-nsn.gov, for contracting and scheduling. Thank you.

Ray Teran

Viejas Tribal Government

Resource Management Director

619-659-2312

rteran@viejas-nsn.gov

Alpine Community Planning Group
PO Box 1419, Alpine, CA 91903

April 7, 2021

County of San Diego, Department of Parks and Recreation
Attn: Alpine County Park Environmental Review
5500 Overland Avenue, Suite 410
San Diego, California 92123
Sent via email: CountyParksCEQA@sdcounty.ca.gov

To Whom It May Concern:

The Alpine Community Planning Group held a public meeting on April 6, 2021 to review and comment on the Notice of Preparation of an Environmental Impact Report for the Alpine County Park Concept Plan. The group made the following recommendations.

Motion to recommend support for the Alpine County Park Concept Plan subject to the Alpine Community Planning Group's review of the final design once the Environmental Impact Report for the project is completed.

The Alpine Community Planning Group specifically requests:

1. *the County review the sustainability of watering the grass field playing areas*
2. *the County works directly with Alpine Fire Protection District and the County Fire Authority on a fire safety plan for the park*
3. *the County reviews the feasibility of all-way stop signs at both entrances to the park to provide traffic calming measures on South Grade Road.*

The motion was made by Jim Easterling and seconded by Mike Milligan. The motion passed with a vote of 11 yes, 0 no, 1 abstain, 3 vacant/absent.

Please include this letter summarizing the recommendations of the Alpine Community Planning Group in the public record.

Best regards,

Travis Lyon, Chairman

From:	Neville Connell
To:	CEQA, CountyParks
Cc:	travislyonacpg@gmail.com
Subject:	Alpine County Park
Date:	Thursday, March 11, 2021 1:28:32 PM
Attachments:	Letter to SD County_Alpine Park 2021_FINAL DRAFT_GAFSC.docx

The Board of the Greater Alpine Fire Safe Council submitted the attached letter to the Alpine Sun where it was published two weeks ago. Its chief concern is that the final design of the park should match the available resources on Wrights' Field, so that the park will be sustainable in perpetuity. After attending the webinar about the current design and hearing County's responses to questions about water, we are concerned that this balance may not be achieved with the design proposed. We therefore ask the County to pay particular attention to this issue in its CEQA study so that the park built will be as attractive in 10 years' time as it was when it opened.

We also propose that open flames of any kind should not be permitted to minimize the chance of ignitions and a repeat of the West Fire. In spite of this ban, fires will occur and the water supply must be sufficient and must be easily accessed by fire fighters.

Finally, we ask that the design pays detailed attention to how children in particular with slate boards and bikes will access the park from the town center and from Joan McQueen Middle School . Expecting them to take Tavern or Eltinge then South Grade, though unlikely to happen in our opinion, is also dangerous under current traffic and sidewalk conditions.

Thank you for your attention.

Neville Connell
President GAFSC

PRESERVE ALPINE'S HERITAGE

ONCE GONE GONE FOREVER

Thursday, April 1, 2021

County of San Diego
Department of Parks and Recreation
Attn: Alpine County Park Environmental Review
5500 Overland Avenue, Suite 410
San Diego, CA 92123
E-mail : CountyParksCEO@sdcounty.ca.gov; lorrie.bradley@sdcounty.ca.gov

Re: Notice of Preparation of a Draft Environmental Impact Report on the Alpine County Park Project

Dear Ms. Bradley:

Thank you for the opportunity to provide information for the Notice of Preparation (NOP) of the Environmental Impact Report (EIR) on the Alpine County Park Project (Project).

Preserve Alpine's Heritage (non-profit status pending) is a group of dedicated community advocates representing all areas and demographics of Alpine. We promote meaningful collaboration and creative partnerships with public representatives and other stakeholders. We embrace a diversity of views as we work toward the common goal of designing innovative, sustainable, and financially-responsible solutions that bring desired facilities and services to Alpine, while preserving the unique natural, cultural, and rural heritage of our community.

We have various issues with the Project including, transportation and traffic, aesthetics, hydrology and water quality, wildfires, biological resources, and public services.

Concern Paragraph 1 - **Transportation and Traffic**. The Project is located on a two-lane road with no sidewalks or crosswalks to neighboring residential areas. The plan contemplates 250-275 parking spaces and potentially 1,000 visitors per week. It is located near two public schools and would be an appealing location for children to walk or ride their bikes, scooters, or skateboards to visit. There already has been pedestrians hit by automobiles on South Grade Road. This concern needs to be analyzed in the Project's EIR. The risk of the safety to all visitors, but especially the children, needs to be eliminated or mitigated below the level of significance.

Concern Paragraph 2 – **Aesthetics.** The Project will have an adverse impact on the existing visual character and quality of the site and its surroundings. Presently, the site has a beautiful view of open space and mountains. At night there is an unobstructed view of the planets and stars since there are no street lights or other light sources on the site. While the County has not been specific on what lights they will utilize on the Project, there has been some discussion of security lights during the evening. This concern needs to be looked into as a part of the Project's EIR and be avoided or greatly mitigated.

Concern Paragraph 3 – **Hydrology and Water Quality**. The County has yet to specify its water source for the Project's extensive landscaping, fields, restroom facilities, etc. Because of that, there has been no investigation of leach field size or location, decrease in ground water supply, or interference with ground water management if wells are the source. The water source must be selected and analyzed as a part of the Project's EIR and assure that a source does not interfere with drainage patterns and ground water supply for neighboring property.

Concern Paragraph 4 – **Noise**. With the contemplated traffic, visitors, and activities, the Project will significantly increase the noise level at the site and the surrounding community. Those that presently use Wright's Field Ecological

Preserve quietly enjoy the trails, wildlife, natural grasslands and trees. With ball fields, basketball courts, biking facilities, and other active sports facilities attracting hundreds of visitors, this quiet enjoyment will be lost. This needs to be addressed and mitigated in the Project's EIR.

Concern Paragraph 5 – **Wildfires**. The Project contemplates fire pits for barbecuing in the park which is a high wildfire zone. This, plus the fire risk associated with the number of visitors to the Project needs to be analyzed as part of the EIR process and the pits need to be eliminated and the other risks avoided or significantly mitigated.

Concern Paragraph 6 – **Biological Resources**. The Project site and neighboring Wright's Field Ecological Preserve are blessed with some of California's Species of Special Concern and natural grasslands. The Project has not addressed the Project's impact on habitat modification of the site or adjacent Wright's Field. This needs to be addressed in the Project's EIR and these resources should be protected.

Concern Paragraph 7 – **Public Services**. The Project will cost taxpayers significant amounts of money both on developing the Project and maintaining it. The source of these funds has not been disclosed. Previously, the County has invested in athletic fields with other government and nonprofit agencies in Alpine to provide recreational space for soccer, softball, baseball, etc. Development of these existing resources should be analyzed in the EIR as the most logical and economic way of achieving what Alpine needs without creating redundant facilities on one new site.

Reasonable Alternative: Small, Nature-Based Park
As outlined in the County's permitting process, the County has to show they have considered reasonable alternatives to the proposed project and they have to demonstrate that their project is the best option. Since County has previously stated they cannot recommend the proposed park site for development "due to significant and not mitigable impacts to biological resources" they need to consider a smaller alternative. The one proposed by Preserve Alpine's Heritage (PAH) is supported by feedback in outreach meetings and independent polling.

The PAH alternative is a much smaller, nature-based park that minimizes the impact on the rare habitat features and significant rural heritage. The most prominently expressed community wishes and needs, as confirmed by the County community outreach efforts and surveys, were nature-based play areas, picnic tables, shade areas, an interpretive area for local history, and protection of the adjacent Wright's Field Ecological Preserve, on-site native grasslands, and Engelmann oak woodland.

As such, please include a project alternative with a smaller, nature-based, minimally developed park that has no impacts to the biological, cultural, and other resources of the project site, Wright's Field Ecological Preserve, and neighboring properties. Focus on making its upkeep and maintenance financially sustainable for the community. Make its construction, maintenance, and rebuilding carbon neutral and environmentally sustainable, to meet federal, state, and County goals.

Reasonable Alternative: Network of Local Parks
Alpine community already has a number of indifferently maintained, underutilized parks and recreational facilities designed to provide many of the amenities this project seeks to build. Why add redundant facilities in one large park? As part of the alternative or in parallel negotiations, the County needs to seek alternate sites (such as Shadow Hills) for the all-terrain bike park, all-wheel park, and the seven acres of sports fields. Multiple distributed sites and options have been identified by the county and by PAH for these larger proposed sports facilities, areas that where there are fewer impacts, and where they are closer to the people who would use them. These local facilities should be connected by a system of safe walkways, bike paths, and trails.

The County needs to revisit joint use and partnering options with Alpine Unified School District for shared investments in sports field facilities at Shadow Hills Elementary School, Joan McQueen Middle School, and other land-holding/management entities to revitalize and upgrade currently neglected, existing, active-recreational facilities with monies already earmarked and/or raised for such projects, rather than building more of the same facilities.

Follow Up
Please analyze all of these potential impacts and avoid the significant ones. Please also provide all updates and meeting notices on this project to info@preservealpinesheritage.org. Additionally, we request a follow up meeting with County of San Diego Parks and Recreation Director, Brian Albright, to discuss the above concerns and how they will be appropriately addressed.

On behalf of the hundreds of the concerned Alpine community members comprising Preserve Alpine's Heritage, we thank you for taking our comments and look forward to your follow up on the above.

Kindest regards,

Julie Simper
Chair, Steering Committee
Co-Chair, Community Outreach Committee
Preserve Alpine's Heritage

Find us on
Tel: (619) 606-8692
info@preservealpinesheritage.org
www.preservealpinesheritage.org
Alpine, California 91901

From: Tom Myers
To: CEQA, CountyParks
Cc: info@alpinehistory.org
Subject: Comments for County Park in Alpine
Date: Friday, April 30, 2021 10:05:38 AM

Good Morning Marcus,
I would like to add one comment to the list for the County Park being planned in Alpine.

In 1998, Alpine was the first ***Certified Community Wildlife Habitat*** in the USA. We have continued to this day as a leader in education related to sharing our home gardens, neighborhoods parks, and open spaces with native wildlife. We urge the planners for this park to include landscape elements that will qualify this park as a certified wildlife habitat. This will be a way to demonstrate how easy it is to share our active community parks with wildlife and it is very simple to do. The landscape design must consider five topics in it's development.

1. FOOD: All living things need to eat to survive, so food sources are a critical component of wildlife habitat. Native plants form the foundation of the food chain in the natural world, and should do the same in wildlife-friendly landscapes. Plants provide food to wildlife in a wide variety of ways, from berries to nuts to pollen, seeds, nectar and even the insects they support that feed other animals.

2. WATER: Wildlife needs clean drinking water to survive. Birds need to bathe in order to keep their feathers in good working order, while other species including some amphibians, insects and other wildlife actually live in water. You can provide this habitat component in a variety of ways, from a simple birdbath or shallow dish of water to a water garden or pond.

3. COVER: Wildlife need places to hide to feel safe from people, predators, and inclement weather. Native vegetation is a perfect cover for terrestrial wildlife. Shrubs, thickets, and brush provide great hiding places within their bushy leaves and thorns.

4. PLACES TO RAISE YOUNG: Wildlife need a sheltered place to raise their offspring. Many places for cover can double as locations where wildlife can raise young, from wildflower meadows and bushes where many butterflies and moths lay their eggs to tall shrubs or trees for nesting species.

5.SUSTAINABLE PRACTICES: Maintaining the landscape in a sustainable, environmentally-friendly way ensures that the soil, air, and water that native wildlife (and people) rely upon stay clean and healthy.Some key sustainable practices that will enhance the park are

- Soil and Water Conservation: Riparian Buffer • Capture Rain Water from Roof • Xeriscape (water-wise landscaping) • Drip or Soaker Hose for Irrigation • Limit Water Use • Reduce Erosion (i.e. ground cover, terraces) • Use Mulch • Rain Garden
- Controlling Exotic Species: Practice Integrated Pest Management • Remove Non-Native Plants and Animals • Use Native Plants • Reduce Lawn Areas
- Organic Practices: Eliminate Chemical Pesticides • Eliminate Chemical Fertilizers • Compost

On behalf of the Certified Wildlife Community Habitat program in Alpine, we request that you include these wildlife friendly concepts in the landscape plans as they continue to develop.

Tom Myers, President
Alpine Historical & Conservation Society
PO Box 382
Alpine, CA
email: info@alpinehistory.org
website: alpinehistory.org
phone: 619-885-8063

From: Alex Carroll
To: CEQA, CountyParks
Subject: Alpine County Park
Date: Wednesday, April 07, 2021 4:55:20 PM

Dear County,

The proposed park has fancy amenities and it's beautifully designed, however, I am opposed to certain elements. Specifically, I'm opposed to the noise elements in the design such as the all-wheels park, bike course, basketball, baseball/softball fields and cemented areas that will carry noise through the field/hills and into the residential areas. I do not live adjacent to the park but I believe the noise level will rise significantly and disturb those who do live nearby and are directly affected by the impacted design. Also, I'm concerned South Grade is a very dangerous road for local children that will attempt to walk/ride to the park. I love the size of the park, the 2 dog parks, the volunteer pad, the playgrounds, trails, grass and gathering areas in the design and I believe a more natural type park, or passive setting, would be best aligned with the community desires and balanced with nature. There are parks such as Damon Lane where children enjoy the open and natural areas just as much, if not more, than over designed or impacted parks such as the proposed park in Alpine. Please scale down the amenities of the park and simplify the design to mimic the surround natural area as much as possible.

Respectfully,
Alex Carroll
2811 Via Asoleado
Alpine
619. 300-6634

From:	Amanda Pavich
To:	CEQA, CountyParks; Bradley, Lorrie
Cc:	Miles Pavich; Dr. Amanda Pavich
Subject:	Comment on NOP Draft EIR- Alpine County Park
Date:	Tuesday, April 06, 2021 8:56:10 PM

Miles & Amanda Pavich

2422 Nido Aguila,

Alpine CA 91901

April 6, 2021

County of San Diego

Department of Parks and Recreation

Attn: Alpine County Park Environmental Review

5500 Overland Avenue, Suite 410

San Diego, CA 92123

By email to CountyParksCEQA@sdcounty.ca.gov and lorrie.bradley@sdcounty.ca.gov.

RE: Notice of Preparation of a Draft Environmental Impact Report on the Alpine County Park Project

Dear Ms. Bradley,

Thank you for the opportunity to provide information for the Notice of Preparation ("NOP") of the Environmental Impact Report ("EIR") on the Alpine County Park Project ("Project"). We

moved to Alpine a year ago with our children expressly for the rural, open spaces, access to nature, and dark skies. We are regular users of active and passive recreation areas/parks. We live across South Grade from the proposed park site, the direct line-of-sight view from our property is the Project acreage.

As neighbors who will be directly impacted by this Project, the CEQA issues we are concerned about include: 1- Traffic safety and noise; 2- Use of tax dollars and cost of Project upkeep/ maintenance; 3- Fire Safety; 4- Lighting and Dark Sky Designation; 5- Property value decline due to changed view ; 6- Alternative Park Design

1. Traffic Safety and Traffic Noise

As stated above, we live across South Grade Road from the proposed park site. We travel on this road to and from our home daily. South Grade is a narrow, two-lane country road with dangerous twists and turns where residents travel at high speeds. The current Project details nearly 300 parking spaces and facilities adjacent to and emptying out onto this road, anticipation of large gatherings, tournaments and events, and no safe walkways, sidewalks or horse trails to get to and from the park. The Project's all-wheels park is a tempting destination for local kids, like ours, to ride to without any safe bike paths or trails to get there. County representatives have described this as a "regional destination park," designed to make people travel by vehicle. This, and the amount of people the mega-park is designed to accommodate, will greatly impact the amount of cars on the road and traffic noise we, as neighbors, will experience. In light of the three deaths that have occurred on that road and the very recent hit- and- run of a teenage girl that left her with serious injuries, it seems utterly irresponsible to proceed with ANY PART of this Project until concrete traffic/road plans are proposed and vetted, and analyzed in the EIR. Our own 18-year- old sometimes has to walk that road on his way to work, if he gets called in when we are away from home with the car.

County representatives have merely stated "we're working closely with other departments on this." Putting out a proposal without a traffic plan demonstrates a lack of understanding of the seriousness of adding large amounts of park traffic to an already dangerous road. Putting enticing play areas to attract local kids-- without a safe way to get them there-- is outrageous. Not providing a safe way for horses to get to and from the park in a horse-community, requiring trailering, also adds to the noise, congestion and safety issues. These traffic safety and noise impacts need to be avoided, or, at worst, mitigated below the level of significance.

2. Cost of Project Upkeep and Maintenance

Alpine already has several active recreational fields (that utilized public funds to build) that are in disrepair, decay, or closed to the public. As taxpayers concerned with good stewardship of undeveloped land AND our dollars, it seems financially irresponsible to replace open space near an Ecological Preserve with a high-cost park with redundant facilities. The Alpine Community Plan Update (COS 4.5) calls for the support of joint powers agreements for park and recreational facilities. It would be far less expensive to taxpayers to repair and/or upgrade existing recreational assets using Joint-Use or Joint-Maintenance agreements, in order to fulfill County recreational/ park goals.

Active-use facilities and grass fields such as those detailed in the Project are expensive to maintain, and many of these facilities in existing County Parks are currently in disrepair, closed, and/or neglected from lack of funds. County representatives have publicly stated "there are many ways to generate revenue for a park" and some general ideas for how parks generate revenue are listed on the website. However, there is no plan detail for how the upkeep and maintenance costs for THIS SPECIFIC PARK will be generated. With tax revenues falling because of the Covid -19 Pandemic, how will this park be any different, once it's built? What is the taxpayer impact if there are not enough funds to maintain these facilities, and what are the actual costs to the local users of the Park?

These questions about utilizing Joint Use/ Joint Maintenance agreements to fulfill County goals while managing taxpayer dollars more effectively, as well as a concrete fiscal plan for continued upkeep and maintenance of the Project need to be analyzed in the project EIR.

3. Fire Safety

Alpine is a high-risk fire area. Our neighborhood has one exit route for fire evacuation, utilizing South Grade Road. The proposed Project would significantly increase traffic and congestion on that road. The situation could become dire if a fire evacuation was needed while a large sporting event or gathering was going on at the proposed sports fields or pavilion. Additionally, the Project includes BBQ pits/grills, a high fire hazard for all of the houses that

surround the proposed Project land, like ours, and for Wright's Field Ecological Preserve. Inclusion of and allowing any type of fire or grilling at this location is utterly irresponsible in light of the sensitive habitat of the adjacent Ecological Preserve and known challenge of a being in high fire-risk area. These impacts must be avoided or, at worst, mitigated below the level of significance.

4. Lighting and Dark Sky Designation

We intentionally purchased a home in Alpine because it is a more rural community with an ongoing Dark Sky Designation in process. We have no streetlights. Our home is on a hill and directly overlooks the proposed site, also with a completely dark, natural nighttime view. The Project calls for a 24/7 live-on site volunteer and "safety lighting," and the ball fields to be "lighting-ready should the people of Alpine decide to add it later in the future," according to the County's representatives in the January public meeting. The lighting required by a permanent resident and for parking lot safety alone will eliminate completely the current dark sky; it will also interfere with local wild animal behavior and the natural beauty of the sunsets, dusks, and starry nights. This is in conflict with Alpine's efforts to achieve Dark Sky designation. These impacts should be avoided or, at worst, mitigated below the level of significance.

5. Home Value Decline Due to Loss of Natural View

One of the key features of our property is the natural view over the County-owned land and Wright's Field Ecological Preserve. We purchased this home because of the beauty of the natural landscape viewed from our property, and paid a premium for it. The Project as drawn would make our direct view, not mitigated by trees or berms, a large, asphalt parking lot, cars and/or solar panels, bathrooms, and turf fields with chain link fences. If these facilities are allowed to fall into disrepair as in similar County Parks, we would be looking directly at an eyesore. Furthermore, depending on the way the solar panels are installed, they would be reflecting directly onto our property. This will negatively impact our resale value beyond any suggested benefit a park might bring. These impacts need to be avoided, or mitigated below the level of significance.

6. Alternative Project Design

We would like to suggest, as an alternative to the current Project, a smaller, nature-based park, with a focus on fiscal and environmental sustainability and native plants. We would like the construction to be carbon neutral, and the Native Peoples to be meaningfully included in the process. This minimally-developed park should have little to no impacts to the biological, cultural, and other resources of the project site, Wright's Field Ecological Preserve, and neighboring properties. It should also address traffic and road improvements needed, and able to meet federal, state, and county goals.

We respectfully request that the potential impacts to both our personal property and safety, and those of the larger community, including traffic safety and noise, financial costs and upkeep, fire safety, effect on Dark Sky Designation, and loss of home value, be analyzed and to avoid the significant ones. Please also make sure that we receive all updates and meeting notices on this project, at ampavich@mac.com and mmpavich@me.com and the mailing address above. Thank you, again, for the opportunity to bring light to these important issues.

Sincerely,

Miles and Amanda Pavich, Alpine Residents

Dr. Amanda Pavich, Ph.D.
DIRECTOR

EastLake Leadership College
A Campus of Southeastern University

(925) 580-1772
eastlake.college

Tom & Julie Dyer — 2650 Calle De Compadres, Alpine, CA 91901
Beverly & David Francis — 2695 Calle De Compadres, Alpine, CA 91901
Larry & Tamara Ham — 2643 Calle De Compadres, Alpine, CA 91901
Jeff & Alanna Light — 2634 Calle De Compadres, Alpine, CA 91901
Kyle Ogle & Dominique Norton — 2623 Calle De Compadres, Alpine, CA 91901
Al & Kelly Wilkey — 2662 Calle De Compadres, Alpine, CA 91901

April 3, 2021

County of San Diego
Department of Parks and Recreation
Attn: Alpine County Park Environmental Review
5500 Overland Avenue, Suite 410
San Diego, CA 92123

CountyParksCEQA@sdcounty.ca.gov and lorrie.bradley@sdcounty.ca.gov.

RE: Notice of Preparation of a Draft Environmental Impact Report on the Alpine County Park Project

Dear Ms. Bradley,

Thank you for the opportunity to provide information for the Notice of Preparation ("NOP") of the Environmental Impact Report ("EIR") on the Alpine County Park Project ("Project"). We are residents of Calle De Compadres which is the cul-de-sac directly across the street from the Project. We are concerned about a number of issues that will directly impact our quality of life.

We are concerned about traffic safety, parking issues in our cul-de-sac, groundwater impact on our wells and the endangered Engelmann Oak trees, noise pollution from the dog park, active sports facilities and high volume of traffic and people, light pollution, septic lines polluting the groundwater and increased fire risk.

One of our biggest concerns is traffic on South Grade Road. It is a dangerous two-lane road with no room for pedestrians or cyclists. This Project will result in more traffic on South Grade Road. Aside from additional traffic accidents, there will be more car pollution and noise. The additional greenhouse gas emissions need to be evaluated in the EIR.

Parking on South Grade Road and Calle De Compadres has increased to a level where our visibility to safely navigate onto South Grade Road is limited. If people are charged for parking, we are concerned that the visibility issues we are already experiencing will be ten-fold. We would like the impact on our visibility avoided and evaluated in the EIR.

Three of the residents in our cul-de-sac have wells. We are concerned that if the Project uses groundwater to keep their extensive grass areas and landscape watered, it will negatively impact our wells, and will impact the health of the Engelmann Oaks at the Project site. We are also concerned that fertilizer leaching into the aquifer, could taint the groundwater. This needs to be evaluated in the EIR. If septic lines are used for the park's restrooms, there is a concern that it could impact the aquifer. This also needs to be evaluated in the "EIR."

Noise pollution is of great concern to us, especially to the residents adjacent to South Grade Road. The increased traffic, dog park and active sports facilities need to be mitigated below the level of significance.

Light pollution will significantly impact our rural community, deter wildlife in the preserved grassland and eliminate the possibility of Alpine being a dark sky community. With the addition of a live-on volunteer, security lights and the possibility of lighting the sports areas in the future, any and all lighting needs to be evaluated in the EIR.

The last concern is fire risk. This Project will attract many additional people to Alpine and we are concerned this will increase risk of wildfire at the adjacent preserve. Whether it's a cigarette, ember from a BBQ pit, or a vehicle backfiring, fire is a big concern. In addition, two-lane South Grade Road is not a feasible road for multiple cars to evacuate in a fire situation. Please evaluate in the EIR what can be done to eliminate this risk and improve South Grade Road to accommodate evacuation in an emergency.

Residents would like to see this park downsized to a community park, which local survey's supported and people voted for in meetings. We would like a nature-based park with little to no impact on the grasslands, as well as no impact on the adjacent Wright's Field Ecological Preserve.

Currently, Alpine has a number of parks that are already in place, underutilized, and poorly maintained. The existing parks in Alpine are centrally located, easy and safe to access, and already have infrastructure in place. Improving our existing parks and continuing to enjoy this peaceful, wonderous open space IS what will BALANCE our beautiful Alpine Community. Instead of spending 28 million to duplicate more parks, consider a more cost effective approach of spending this money to improve what we already have. Just because the County doesn't own the parks, doesn't mean there isn't parkland for residents of Alpine.

In conclusion, please analyze the above potential impacts that this Project will have in our community and avoid the significant ones. Please also make sure that we receive all updates and meeting notices on the project at the addresses included above.

Thank you, in advance, for listening to our comments.

Sincerely,

We, the undersigned.

Tom & Julie Dyer
Beverly & David Francis
Larry & Tamara Ham
Jeff & Alanna Light
Kyle Ogle & Dominique Norton
Al & Kelly Wilkey

From:	Robert Figari
To:	CEQA, CountyParks; Bradley, Lorrie
Subject:	Alpine County Park Environmental Review
Date:	Monday, April 05, 2021 2:10:35 PM

TO: County of San Diego, Department of Parks and Recreation
Attn: Alpine County Park Environmental Review

Hello, I've lived in Alpine almost three years. Our family moved here from a similar rural area in Northern California because we like to see the stars at night, hear the sounds of birds and animals and enjoy the scenic beauty of the area. I walk and mountain bike along the trails of Wright's Field regularly.

I have several concerns about the potential environmental impacts of the proposed park design:

- **Tribal Cultural Resources**: I did not see Tribal Cultural Resources specifically noted in the NOP and expect to see a complete analysis in the EIR.
- **Hazardous Materials**: Given the number of acres devoted to artificial turf and natural grass, I'm concerned about hazardous chemicals and pesticides needed to install and maintain the surfaces in good condition. I request to see an analysis of the chemicals and pesticides that will be used over the life of the park and the impact on, among others, neighboring wells, surrounding watersheds and biological resources.
- **Biological Resources**: In addition to an analysis of the impact of hazardous materials (chemicals and pesticides used on the artificial turf and natural grass) on biological resources, the EIR should include a thorough analysis of the other direct and indirect effects on biological resources, such as the introduction of gophers, moles, skunks and other non-native species.
- **Wildfire**: As a local resident and having just lived through the recent Valley Fire, I have serious concerns with the projected park usage (270-plus parking spaces) during fire season. The EIR must provide substantial and quantitative evidence that operation of the park will not impair the emergency response plans, impact escape routes and will not expose people to significant risk resulting from wildfires.
- **Alternate sites**: There is much public debate and many unanswered questions about the environmental impacts of this proposed park. Because of this, I expect to see a thorough analysis of alternative sites at different locations and of different sizes, including substantial and specific evidence for why other sites for the proposed park are not feasible.

In the EIR I request that:
1) all of the aforementioned concerns be thoroughly analyzed,
and that
2) the impacts of these concerns are avoided or mitigated below the level of significance.

I also respectfully request that you keep me up to date on all project updates, notifications and documents.

Thank you!

Bob Figari

rfigari@well.com
415 259-8153

From:	Frank Landis
To:	Bradley, Lorrie
Cc:	Julie Simper; Preserve Alpine"s Heritage Dominique Norton; Justin Daniel; President Cnpssd; Nick Jensen; George Courser
Subject:	NOP and lack of true scoping meeting on Alpine County Park Project
Date:	Wednesday, March 31, 2021 10:27:43 AM
Attachments:	image001.png

Dear Ms. Bradley,

I am puzzled by the email sent out March 30 (subject: NOTICE OF EIR SCOPING MEETING, at end). I have never heard a YouTube video referred to as a meeting, especially when the purpose of the meeting is (per 15082(c)): "to assist the lead agency in determining the scope and content of the environmental information" that may be required in the EIR.

While it is not clear that a notice of a scoping meeting should be part of the NOP itself, the NOP on the current project did not apparently contain notice of a scoping meeting. This is a problem, because the NOP is publicly available, while the Scoping Meeting notice apparently was only sent out to people who have already expressed an interest in the proposed project. Anyone else who has an interest--perhaps the local tribes?--were not notified.

This is particularly confusing, given that the County has recently issued very different NOPs. This quote below, for example, was part of the December 23, 202) NOP for the County Climate Action Plan: "Consistent with Section 21083.9 of the CEQA Statutes, a public scoping meeting will be held to solicit comments regarding the scope and analysis of the Supplemental EIR. On March 17, 2020, California Governor Gavin Newsom issued Executive Order N-29-20, relating to the convening of public meetings in the State of California in response to the COVID-19 pandemic. The Executive Order outlined requirements for public meetings to take place telephonically or electronically without the need for the public or agencies to attend in person. This meeting will be held virtually on January 28, 2021, 6:00 p.m. to 8:00 p.m. Please follow this link for instructions on how to participate in this virtual scoping meeting: CAP Update….Comments on this Notice of Preparation document will be accepted for 57 days."

This example suggests a solution to the issue that should satisfy all concerns:
--schedule a scoping meeting on Zoom
--Issue a new NOP with a revised date and notice of the Scoping meeting.

Unlike the County Climate Action Plan, Alpine County Park is not urgent, and no one's interests will be harmed by extending the comment period for the NOP. Certainly it will not hamper the County in preparing the draft EIR on this project.

Moreover, this will give the County a chance to double-check their Initial Checklist for the project. We were surprised to note that the County did not think that Tribal Cultural Resources or Energy resources were potentially significant on this project. We know the Kumeyaay are very interested in Wright's Field, and the County has embarked on a plan to go carbon neutral by 2035, a goal requiring energy efficiency. Perhaps whoever prepared the Initial Checklist for this project did not use the most recent checklist available, or filled it out in haste? In any case, issuing a new NOP and holding a virtual scoping meeting to gather information would let these issues be amicably resolved in everyone's favor.

Please feel free to contact me with any comments or questions. Please also keep me on the list to receive all documents and notices related to this project.

Sincerely,

Frank Landis
Conservation Chair, CNPSSD

MARCH 30, 2021 EMAIL:

On Tuesday, March 30, 2021, 8:30:11 PM PDT, CEQA, CountyParks <countyparksceqa@sdcounty.ca.gov> wrote:

NOTICE OF EIR SCOPING MEETING

PROJECT TITLE: ALPINE COUNTY PARK PROJECT

SCH #: 2021030196

APPLICANT: County of San Diego Department of Parks and Recreation

LOCATION: The project is located on South Grade Rd. between Deland Dr. and Boulder Oaks Ln. in the unincorporated community of Alpine in San Diego County.

NOTICE IS HEREBY GIVEN that the County of San Diego, Department of Parks and Recreation (DPR), as lead agency, is holding a Scoping Meeting pursuant to Section 15082(c)(1) of the State CEQA Guidelines.

Due to COVID-19 restrictions on gatherings, an in-person public meeting is not possible. Therefore, the EIR scoping meeting will be in the form of a recorded presentation. DPR is using this format to allow you to view the presentation at your convenience and to allow as many people as possible to provide input.

On March 8, 2021, a Notice of Preparation (NOP) of a Draft Environmental Impact Report (EIR) was published for the Alpine County Park Project. The purpose of the public comment period is to solicit input and feedback from various agencies, stakeholders, and the public pertaining to the scope and content of the environmental information that will be included in the EIR. The public comment period for the NOP is from March 9, 2021 – April 7, 2021.

Project Description: The proposed project involves the development of an approximately 25-acre active park.

Availability: The recorded presentation along with the EIR Scoping materials can be viewed via the DPR website:

https://www.sdparks.org/content/sdparks/en/AboutUs/Plans/public-review-documents.html

or via direct link:

https://www.youtube.com/watch?v=xyKiPTawDsQ

Comments: Due to the time limits mandated by state law, your written comments on environmental concerns must be sent no later than **5:00 p.m. on Wednesday, April 7, 2021.** Information on how to submit comments can be found on the DPR Website.

For questions regarding the EIR Scoping Meeting or the Notice of Preparation, please contact Lorrie Bradley, Environmental Planner, at (619) 455-7721 or by email at lorrie.bradley@sdcounty.ca.gov.

From: Sandy Castle
To: Bradley, Lorrie
Subject: Hi Lorrie
Date: Wednesday, March 10, 2021 10:50:17 AM

I sincerely hope this goes through. I'd love to have a dog park, and the kids need this. Alpine is growing day by day and we need to grow along with it. Thank you, Sandy

From: MIKE HEIDTBRINK
To: CEQA, CountyParks
Cc: Bradley, Lorrie
Subject: Alpine County Park
Date: Monday, March 29, 2021 5:24:09 PM

This email is in response to the letter we received concerning the 25 acre development of a public park at the current location of Wrights Field in Alpine.

My husband, 4 children and I moved to Alpine 4 years ago after living in the SDSU area for 35 years. We were tired of city living, the noise, congestion, and over development. We have enjoyed the quiet, rural feel of Alpine and have spent many days hiking in Wrights Field since our move. We were delighted and surprised to find such an unadulterated gem. Imagine our dismay when we began hearing rumors of a large county park being planned adjacent to such a very sensitive nature preserve - one which has been kept quite untouched despite the growth around it. We attended the first two "community input" meetings and personally saw the response from the community. What is being proposed is a gross inflation of that idea.

What disturbs me the most is the politics I see behind the scenes in this situation. Those of us voicing concern over the over reach of the board are being put off as "a small group", or being patted on the head and told, "Thank you for your input". I can tell you, we are not a small group, and what you are doing if you go forward with this overblown project is a travesty that cant be undone.

I understand the need for some development at the site according to the needs of those who live here - equestrian staging, an off-leash dog area, a bit more development of the trails, some adequate parking and perhaps a skate park. The rest of it will create litter, noise and light pollution, disturb the wildlife living in Wrights Field, disrupt existing wildlife corridors, create congestion on South grade Rd. and forever change what was once a beautiful and unique area, all in the name of progress.

Please search your consciences and listen to the Alpine Community. Or perhaps take a hike in Wrights Field and sit for a moment to take in what is already there - something which cannot be experienced in any of our other County Parks, and should remain as it is.

Best Regards

Elaine and Mike Heidtbrink

Seth, Sam, Sierra and Shenoah

From: Brad Bach
To: CEQA, CountyParks
Subject: Re: Alpine County Park - Notice of Preparation of a Draft Environmental Impact Report
Date: Tuesday, March 09, 2021 6:15:02 PM

Hey Ron,

I looked at the links but didn't see any environmental reports. All I saw was that they would be having meetings and people could comment on the environmental reports, but they were nowhere to be found. Maybe I'm just not seeing it. Did you see them on this email?

Brad

On Tue, Mar 9, 2021 at 5:52 PM CEQA, CountyParks <CountyParksCEQA@sdcounty.ca.gov> wrote:

> **NOTICE OF PREPARATION**
>
> **of a**
>
> **DRAFT ENVIRONMENTAL IMPACT REPORT**
>
> **PROJECT TITLE:** ALPINE COUNTY PARK PROJECT
>
> **APPLICANT:** County of San Diego Department of Parks and Recreation
>
> **LOCATION:** The project is located on South Grade Rd. between Deland Dr. and Boulder Oaks Ln. in the unincorporated community of Alpine in San Diego County.
>
> NOTICE IS HEREBY GIVEN that the County of San Diego, Department of Parks and Recreation, as lead agency, is preparing an Environmental Impact Report (EIR) for the Alpine County Park Project. The County is soliciting input and feedback from various agencies, stakeholders, and the public pertaining to the scope and content of the environmental information that will be included in the EIR.
>
> **Project Description:** The proposed project would involve the development of an approximately 25-acre active park that would include potential multi-use turf areas,

baseball field, all-wheel area, bike skills area, recreational courts, fitness stations, leash-free dog area, restroom facilities, administrative facility/ranger station, equestrian staging with corral, nature play area, community garden, volunteer pad, picnic areas with shade structures, picnic tables, game table plaza, and trails.

Availability: The project description, location, and possible environmental effects of the proposed project can be viewed and downloaded at:

http://www.sdparks.org/content/sdparks/en/AboutUs/Plans/public-review-documents.html.

Comments: Due to the time limits mandated by state law, your comments on environmental concerns must be sent at the earliest possible date but no later than **5:00 p.m. on Wednesday, April 7, 2021.** Comments should be directed to:

County of San Diego, Department of Parks and Recreation

Attn: Alpine County Park Environmental Review

5500 Overland Avenue, Suite 410

San Diego, California 92123

or emailed to:

CountyParksCEQA@sdcounty.ca.gov. Please include “Alpine County Park” in the subject line of the email.

For questions on this Notice of Preparation, please contact Lorrie Bradley, Environmental Planner, at (619) 455-7721 or by email at lorrie.bradley@sdcounty.ca.gov.

From:	Dominique Norton
To:	CEQA, CountyParks; Bradley, Lorrie; Lubich, Marcus
Cc:	Pisano, Nina
Subject:	Re: Alpine County Park - Notice of Preparation of a Draft Environmental Impact Report
Date:	Thursday, March 18, 2021 6:34:08 PM

Hello,

I would like to provide my name, Dominique Norton, and address 2623 Calle de Compadres, Alpine, CA 91901, and request to receive any future communications of any type relating to the project, as well as information on the following:

1. Who are the "agencies, stakeholders", and the identified members of the public who are included as recipients of your notice, and how widely will those members of the public be solicited for comment on the NOP, and subsequent review and decision processes?

2. When was the park proposal initiated, and what prior public input regarding the proposed park has been received or requested by the Department?

3. Are you subject to Special District assessment to pay for any of those costs that are different from other areas of the County?

4. What is/are the funding sources for the park for acquisition, development, and long-term operations?

5. Who prepared the initial study that led to the determination that the project would have a significant adverse effect on the environment, and is a copy of that study available to me?

6. If any conclusion arising out of the initial study suggested local impacts may be significant, what resources are potentially subject to a significant adverse effect, and which may particularly affect the neighboring property owners and community?

The above questions are merely threshold questions, and that further comments may be provided after I have a chance to consider both the NOP and any of the information listed above.

Thank you,
Dominique

> Begin forwarded message:
>
> **From:** "CEQA, CountyParks" <CountyParksCEQA@sdcounty.ca.gov>
> **Date:** March 9, 2021 at 6:01:34 PM PST
> **Subject: Alpine County Park - Notice of Preparation of a Draft Environmental Impact Report**

NOTICE OF PREPARATION

of a

DRAFT ENVIRONMENTAL IMPACT REPORT

PROJECT TITLE: ALPINE COUNTY PARK PROJECT

APPLICANT: County of San Diego Department of Parks and Recreation

LOCATION: The project is located on South Grade Rd. between Deland Dr. and Boulder Oaks Ln. in the unincorporated community of Alpine in San Diego County.

NOTICE IS HEREBY GIVEN that the County of San Diego, Department of Parks and Recreation, as lead agency, is preparing an Environmental Impact Report (EIR) for the Alpine County Park Project. The County is soliciting input and feedback from various agencies, stakeholders, and the public pertaining to the scope and content of the environmental information that will be included in the EIR.

Project Description: The proposed project would involve the development of an approximately 25-acre active park that would include potential multi-use turf areas, baseball field, all-wheel area, bike skills area, recreational courts, fitness stations, leash-free dog area, restroom facilities, administrative facility/ranger station, equestrian staging with corral, nature play area, community garden, volunteer pad, picnic areas with shade structures, picnic tables, game table plaza, and trails.

Availability: The project description, location, and possible environmental effects of the proposed project can be viewed and downloaded at:

http://www.sdparks.org/content/sdparks/en/AboutUs/Plans/public-review-documents.html.

Comments: Due to the time limits mandated by state law, your comments on environmental concerns must be sent at the earliest possible date but no later than **5:00 p.m. on Wednesday, April 7, 2021.** Comments should be directed to:

County of San Diego, Department of Parks and Recreation

Attn: Alpine County Park Environmental Review

5500 Overland Avenue, Suite 410

San Diego, California 92123

or emailed to:

CountyParksCEQA@sdcounty.ca.gov. Please include "Alpine County Park" in the subject line of the email.

For questions on this Notice of Preparation, please contact Lorrie Bradley, Environmental Planner, at (619) 455-7721 or by email at lorrie.bradley@sdcounty.ca.gov.

From: cfigari@well.com
To: CEQA, CountyParks; Bradley, Lorrie
Subject: Alpine County Park Environmental Review
Date: Monday, April 05, 2021 11:28:50 AM

Greetings,
My husband and I moved to Alpine two years ago from Northern California and live in Rancho Palo Verde. I regularly walk on Wright's Field MSCP Preserve and almost daily we must travel on South Grade Road when we leave our home for any destination in Alpine, or beyond.

I have studied the proposed park plan for Alpine and have several concerns about the potential environmental impacts. **In the EIR I request 1) the following items to be thoroughly analyzed and 2) that impacts are avoided or mitigated below the level of significance.**

- Aesthetics: Given the significant changes to the property as it currently exists, I need evidence that the park will not have a substantial negative impact on the scenic vista and quality of public views. I therefore expect the EIR analysis to include visual simulations from a variety of locations.
- Wildfire: Given the fire danger in the area and that South Grade Road is the only road most residents in the area can use to evacuate, I need evidence that in the event of a wildfire when the proposed park is at full capacity, emergency evacuation plans will not be impacted.
- Traffic: Given the expected usage of the proposed park (270-plus parking spaces), I need to see a traffic impact analysis that focuses on level of service/peak hour trips (especially the impact on emergency services and access), in addition to the vehicle miles traveled analysis.
- Noise: Please ensure that the noise assessment in the EIR includes an analysis for ALL sensitive receptors such as hikers, biological species, and tribal cultural resources.
- Alternatives Analysis: Given the significant environmental impacts associated with this park project, including the proposed size, number of amenities, number of parking spots and this particular location, I expect that the alternatives analysis will include several alternatives at different locations and of different sizes, all of which are analyzed fully (not just considered but dismissed) with substantial evidence for why other sites for a proposed park are not feasible.

Please be sure I am notified of all project updates, notifications and documents.

Thank you,
Christine Figari

cfigari@well.com
Landline: 619-722-1993

Patrick L. Williams Ph.D.
Geomorphology, Neotectonics
PO Box 1437
Alpine CA 91903

April 6, 2021

County of San Diego
Department of Parks and Recreation
Attn: Alpine County Park Environmental Review
5500 Overland Avenue, Suite 410
San Diego, CA 92123
By email to CountyParksCEQA@sdcounty.ca.gov and
lorrie.bradley@sdcounty.ca.gov

RE: Notice of Preparation of a Draft Environmental Impact Report on the Alpine County Park Project

Dear Ms. Bradley,

Thank you for the opportunity to provide information for the Notice of Preparation of the Environmental Impact Report (EIR) on the Alpine County Park. I am a professional geologist specializing in geohazards and landscape analysis. For six years I served as BCLT Operations Director for almost 4000 acres of high-value-habitat located in Potrero (Long Potrero) and Campo (Clover Flat). My academic training includes project design, zoology, botany and geology. During my time managing BCLT properties I worked closely with staff of multiple state and federal entities and other individuals and organizations too numerous to name. Relationships with this network continue beyond my association with BCLT.

Below please find comments on *geology, biological issues, wildfire, noise and traffic* that need to be addressed in an EIR for the proposed Alpine County Park.
I implore the County to evaluate all current options to distribute park facilities in Alpine. The proposed park measures at least 28 acres, more than twice the size indicated in early press and social media discussions which were widely read by Alpine residents. I urge County Parks to analyze a smaller, less impactful, sustainable park design on the South Grade property as an alternative. A map of large land tracts in Alpine is attached below. Many of these are more central and several are much more suitable for the amenities proposed in the current park plan. However challenging, I believe it is necessary to continue to investigate possible park location(s) to achieve a park(s) without essential destruction of unique, rare, extremely high-value habitat and scenic splendor.

Geology
In my first acquaintance with BCLT, in Fall 2014, I was invited to a field meeting with Jon Green and Yolaine Stout. The outing took place after I inquired regarding

the status of the property at the exact site of the proposed Alpine County Park. The uniqueness of the site had captured my attention. Not only is the park area a striking native grassland, nearly devoid of woody "chaparral" species, but the entirety of the property's grassland is decorated with exotic boulders of a very large and very ancient riverbed, which, per SDSU faculty cannot be associated with a provenance because the mountains of their origin have long since disappeared. The field itself was an active riverbed until about eighty-million years ago, at which time the river's flow was captured into Sweetwater Canyon. Such a site is not only unique in southern California, it is extremely rare in the world. The County property and Wright's Field is a geological heritage site and deserves to be formally recognized as such. Investigation of the geological uniqueness of the site is a necessary component of the EIR process. I am happy to volunteer to assist the County in facilitating a site study by local academic geologists.

Botany/Zoology

Taking of 30 acres of native grassland and Engelmann Oak habitat is communicated as a very serious matter in the County's own documents: "Native grasslands are now quite rare and occur [only] in the hills south of Poway, Wright's Field in Alpine, parts of Camp Pendleton, Ramona, and Rancho Guiejito east of Valley Center." Furthermore the County previously stated that development of the site of the proposed Alpine County Park could not be mitigated in their opinion towards a search for locations for an Alpine high school:
(DPLU/ DPW/ DPR dated 2/20/2009 "Due to the significant and not mitigable impacts to biological resources for Alternative B (Wright's Field) and the direct implications to the County's Multiple Species Conservation Plan, the County cannot recommend that this site be chosen for such an intensive land use. Study Area B is located within the County's Wright's Field Pre-Approved Mitigation Area (PAMA) and adjacent to Wright's Field Preserve, an integral part of the County of San Diego's South County Multiple Species Conservation Program (MSCP) Subarea Plan.").
Development of a park of this size and impact, at a location that the County previously stated development could not be mitigated, is an important contradiction. The projects EIR needs to explain the difference in review that concluded previously that development of the park site could not be mitigated.

Wildfire

It is incredible that wildfire has not burned across the area of the County's Alpine property and Wright's Field Preserve since the *1970 Laguna Fire*. During the *2018 West Fire,* scene command was certain the fire would run west across the grassland and extend indefinitely into neighborhoods in that direction. This terrible outcome was inhibited, but not prevented, by firefighting. The primary reason the fire was able to be brought under control was a drop in wind and temperature. It is certain that a large increase of potential ignition sources will be introduced by smoking materials of youth (and other park users) crossing and assembling in grassland while coming and going from the proposed park attraction. Near certainty of eventual occurrence of a fire ignited auxiliary to the transit of "thousands of daily

park users and hundreds of daily users of adjoining land" (per Rhodes and Associates fire hazard investigation).
A real question arises whether the park should remain open during wind events. I feel strongly that park-caused increases of fire hazard to adjoining habitat areas and extended neighborhoods needs to be more deeply and critically evaluated in the EIR process.

Noise
It is essential that an EIR noise study for the propose park include "nonlinear" impacts due to sound direction and amplification that may be caused by abrupt local topographic features. An steep 220 foot-high granite hill is located across South Grade Road, very close to the park. This feature will almost certainly direct and amplify sound northward. Fifty-foot high granite hills northwest and north of the proposed park will likely redirect sound into the neighborhoods to the east and south. Finally the 250 foot-deep canyon containing Viejas Creek is located close by to the east of the proposed Park. The granite-walled canyon of Viejas Creek is a demonstrated noise echo chamber and the impact of noise from localized large group sports play may be impossible to mitigate. Technical evaluation of these unique local topographic features on noise direction and amplification (individually and collectively) needs to be included in EIR study of noise impacts of the due to the proposed park.

Traffic
Wind driven fire is certain to impact the proposed park site and surrounding neighborhoods in the foreseeable future. A significant fire bearing down from the east during a Santa Ana wind pattern will require evacuation of about 500 homes and up to 1000 vehicles onto South Grade Road. I have attached a "Fuels Map" which I drafted for my interest in fire fuels distribution across Palo Verde Ranch, Ranch Palo Verde and neighborhoods surrounding the proposed park site.
Parking for up to 300 additional vehicles at Alpine County Park is now proposed. Taking the worst case, which is the most conservative evaluation, of a fire occurring during the daytime on a weekend, within a high time-of-use for the park, up to 300 vehicles would exit onto South Grade Road, slowing normal traffic (up to a few vehicles per minute) and eventually backing up at controlled intersections. A line of 300 cars is almost exactly one mile in length (https://www.quora.com/How-many-cars-make-up-a-mile), thus without any cars entering South Grade Road from the adjacent communities, cars could be backed up to Tavern Road or to Alpine Boulevard. With the addition of cars entering from surrounding homes traffic could quickly back up in both directions to such a degree to produce a hazard of enormous proportions. Evaluation of various "worst-case" scenarios should be an integral part of EIR traffic studies for the proposed Alpine County Park.

Project Alternatives
Given all of these concerns a DEIR should include a project alternative with a smaller, nature-focused, minimally-developed park that has no impacts to the biological, cultural, and other resources of the project site, Wright's Field Ecological

Preserve, and neighboring properties. Given voiced community concerns about the lack of maintenance on existing Alpine parks, please focus on making park upkeep and maintenance financially sustainable for the community and County. Also make its construction, maintenance, and rebuilding carbon neutral and environmentally sustainable, to meet federal, state, and county goals. Please also analyze each and every project alternative equally, as unequal analysis has been contentious on past county projects.

Thank you for taking this input. Please keep me informed of all developments with this project and associated documents and meetings, at the address below or by email to geoplw3@gmail.com

Respectfully

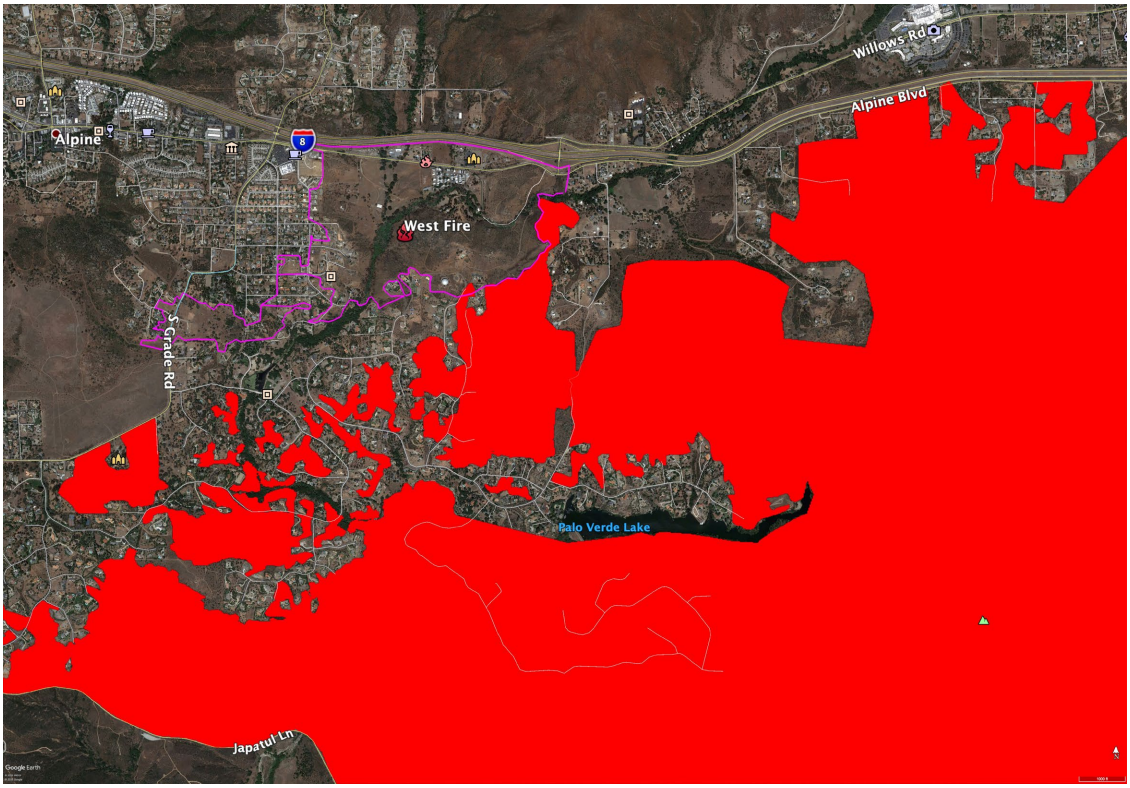
Patrick Williams PhD
PO Box 1437
Alpine, CA 91903

Attachment 1. Selection of "Alpine Recreation Areas and Larger Land Parcels" identified by SDPR and Preserve Alpine's Heritage

Attachment 2. Draft Fuels Map of PVR, RPV and surrounding areas – Dr. Pat Williams

From: Patrick Williams
To: Bradley, Lorrie; CEQA, CountyParks
Subject: Re: Alpine County Park NOP
Date: Tuesday, April 06, 2021 4:45:33 PM

Attachments to PL Williams Letter:
Attachment 2. Draft Fuels Map of PVR, RPV and surrounding areas – Dr. Pat Williams



Attachment 1. Selection of "Alpine Recreation Areas and Larger Land Parcels" identified by SDPR and Preserve Alpine's Heritage:

On Tue, Apr 6, 2021 at 4:38 PM Patrick Williams <geoplw3@gmail.com> wrote:

> Laurie,
>
> Please find comments attached.
>
> Thanks very much,
>
> Pat
>
> --
> Patrick Williams
> Williams Associates
> 508-274-9618
> PO Box 1437

Alpine, CA - 91903


Alpine Parks and Larger Parcels
AID 17 acres
P&R 2.9 acres
Blackwolf Partners 184 ac
Alpine elementery playing fields 2 acres
Alpine Community Center fields 2 acres
Park Meadows Inc 4ac
Alpine Fire District 3.1ac
AUSD rec area 2.5 ac
P&R 1.8 acres
P&R 2.4 acres
OAA 23ac
Jabro 25ac
Thorman 33 ac
P&R 9 ac
P&R 4.4 ac
Shadow Hills AUSD recreation area 11 acres
Yee Group 5ac
Nelson 3.5ac
Albertsons hill 1.5 acres
P&R 4.6 acres
P&R 1.8 acres
Bailey 14 acres
AID46 ac
P&R 19 ac
Walser 12.5ac
Halstead - Tyler 15.5ac
P&R 2.6 acres
Kniffing 21.5 ac
P&R 29 ac
Bailey 12 acres
Augustyn 49 ac
P&R 21 ac
willing seller 9 ac
Flodo Properties LLC 7ac
Fawns Trust 6.8ac
JMMS AUSD Fields 9 acres
Coleman 21 Acres
Lionhead Properties LLC 21ac
Boulder Oaks park
28 acre County Sports Park
Tent City Dev Corp 20 ac
Wise 63 ac

From: Peggy Easterling
To: Bradley, Lorrie
Subject: Alpine park
Date: Wednesday, March 31, 2021 6:08:33 PM

Please consider changing the community garden area to a “Sage, Songbird and butterfly garden”. This is nod to the history of Alpine.

Peggy Easterling

Sent from my iPad

From: PAT
To: CEQA, CountyParks
Subject: "Alpine County Park"
Date: Wednesday, March 10, 2021 6:57:30 AM

Good Morning,
The very idea of a park like what the county is proposing is exactly what the people of the Alpine community do not want.

I have lived in Alpine for over 20 years.

The people of Alpine have fought hard to keep our area known as Wright's Field out of developers hands.

The Alpine Planning Group is made up of people that do not represent Our community. They merely are interested in profiting from this Park from various vendors that will be needed to install things like turf.

We only want to preserve it as a quiet park that the locals could hike in And enjoy in its natural state. The County people do not realize what the Alpine people want.

The County people asked everyone in town for ideas and got plenty. These Ideas are fine for a park on land in the area, but not on this field and area Of natural beauty.

If you have 38 million dollars to work with,
Why not purchase an area where this kind of park would be appropriate?
It is not in Wrights Field.

For the County's information:

The land is composed of clay and does not perk, which means Thousands of dollars will be needed to grade it. Grading this site Will destroy the beauty of this beautiful Open Space. Why do places Like Julian get to have open hiking only areas, and we do not in Alpine?

The land is filled with huge amounts of granite boulders. When Joan McQueen Middle school was built, huge amounts of rock got in the way of the grading.

Why put a sports complex in a beautiful open space such as Wright's Field?

Why not put a park like the one proposed for this site on the Site of the Double A Ranch where the new high school was supposed to go?

What about the site on the North side of I-8 that was owned by Tom Dyke?

What about other appropriate sites east of Albertsons?

What would this proposed plan by the County people do to our community?

It would allow lots of criminal activity for drug dealing at the park.

It would open up the nearby residential areas to burglary activity and the crime Rate Would rise dramatically.

The fire danger would hugely increase exposing the nearby residents to loosing their Homes and possessions.

It will increase their fire insurance costs and make it very costly to insure their homes.

If there were a fire, people In the community would have a difficult evacuation.

Where is the water coming from necessary to support this "plan"?

There are many trees planted on the "plan". The clay will not support this Landscape.

It will increase traffic noise and make the quiet rural area crowded and unpleasant.

Why would the county desire nearly 300 parking spaces in an area where only 10 to 20 cars use daily? A small parking lot on the South side would be the Only part of this plan that makes any sense for just 20 to 30 cars is the only Thing that is needed.

Why would the County encourage bringing people into our quiet Peaceful community so people who do not live in the area will create Noise from all the activities this plan would encourage in our community?

This is part one of my email.
It will be continued later
Sincerely,
Patricia Barton

Sent from my iPad

From: nicole@pacific-ps.com
To: CEQA, CountyParks
Cc: nicole@pacific-ps.com
Subject: Alpine County Park
Date: Wednesday, March 10, 2021 1:55:41 PM

I am writing in response to the proposed plan to build a park in Wright's Field.

As a resident of Palo Verde Ranch and with a direct view to Wright's Field from my home, I am opposed to this "sports complex".

A park, is manageable and feasible for this area. The majority of my neighbors do not oppose a true park as originally proposed. The current plan is presenting a sports complex, something that is not wanted, and will create nothing but problems for those who live nearby. I do not want to imagine the increased traffic on an already unsafe road, let alone the "undesirables" that this project can attract to this peaceful back side of Alpine.

Aesthetically – I would rather look at the natural landscape of Wrights Field than a parking lot, lights, buildings, not to mention the fencing
Land use and planning – planning, involving, and listening to locals, people who actually live here, would be nice. I feel blindsided by the this expansive project
Noise – there is none now, this is how we like it, and this is why we chose to live here
Recreation – wrights field is used by many in the way it is intended to be used. As a natural landscape
Transportation and traffic – nothing positive in regards to traffic will come from this project
Wildfire – this project will open wrights field to more risk for wildfire, especially by bringing people into this area who are not as familiar with the risks as those who live here are aware.

The purpose of my email is to make you aware that I am highly opposed to this project in its current state. If the county cares to take into account those opposed, please be sure to include me in that number.

Thank you,
Nicole Stockmoe
3113 Via Luiseno
Alpine, CA 91901
Direct# 619) 540-0559

From: Michelle Rader
To: CEQA, CountyParks
Subject: Alpine County Park
Date: Wednesday, April 07, 2021 3:43:51 PM

Hello San Diego County Parks and Recreation,

I would like to add the following comment for the Alpine County Park Environmental Review.

Thank you,

Michelle Rader
3155 Via Viejas
Alpine, CA 91901
michelle.rader@sbcglobal.net

I'd like to start by saying I do love parks of all shapes and sizes, and have a great appreciation for community and public places that allow for all community members to enjoy a wide variety of healthy activities.

And I would love to be able to highlight examples of park uses I consider ideal for this location. But unfortunately my time is too short for proper research and inadequate for any real discussion or presentation of substantial evidence regarding the potential environmental and community impacts of similar examples. Thankfully, I know other members of the Alpine Community have completed extensive research and review and no doubt will have presented this to you for consideration.

My family has lived here in the Palo Verde Ranch area for 40 years. The open space of Wright's Field has been a treasure throughout these years. It is this semi- rural environment that drew my family to the Ranch to begin with. Safety, quiet and low traffic were and still are a big part of it. I would like to see it remain a quiet, treasured open space for future generations.

There's a wonderful opportunity to do what's right for Wright's Field and the surrounding community. Spending millions to bulldoze it and cover it in sports facilities and pavement isn't the highest and best use, and it will destroy the opportunity to preserve and celebrate the natural beauty we all love and treasure.

The county should step back and realize 'bigger' is not always better. And sometimes 'progress' is achieved by letting go of big ideas and embracing the beauty that already exists. Preservation is a positive. And nature is necessary. Let's nurture that nature and preserve it for future generations. We will reap far greater benefits in the long run, with far fewer costs.

The location of Wright's Field, the transportation infrastructure, and the surrounding

neighborhoods, are inappropriate for the scope and scale of the county's park plan. A location closer to town center and the freeway would better serve the entire community, and would be safer for everyone. Or the money could be better spent through improving the large number of public facilities already existing in the Alpine area.

Many examples exist of ecologically sensitive passive parklands that highlight the natural and historical resources while preserving them and also providing recreational and physical fitness opportunities. Time spent in physical activity in a natural environment has been proven time and again to benefit us both physically and mentally. THIS is the highest and best use of Wright's Field in its entirety, and THIS is what I ask of all of you to reconsider moving forward.

Again, thank you,

Michelle Rader

To: CountyParksCEQA@sdcounty.ca.gov

From: Yolaine M. Stout _ Ystout11@gmail.com

Re: NOTICE OF PREPARATION of a DRAFT ENVIRONMENTAL IMPACT REPORT :

PROJECT TITLE: ALPINE COUNTY PARK PROJECT

APPLICANT: County of San Diego Department of Parks and Recreation

My concerns for above-referenced project include -but are not limited to- the following.

I request that these are addressed in the draft EIR.

1. Known endangered species near or on the proposed site include the endangered Quino Checkerspot Butterfly and the San Diego Thornmint. Please indicate how this project will impact these species in particular. Additionally, describe impacts to the habitat for the critically imperiled Hermes Copper Butterfly known to be present on Wright's Field.
2. Of the 25 acre proposed Alpine County Park Project Map, it is estimated that 20 of those acres will destroy high quality California Native Valley Needle Grassland will be destroyed in addition to the 20 acre impact from Joan MacQueen Middle School and surrounding homes. The grassland area (Mesa del Arroz) was estimated to have originally been ca. 400 acres. Currently, the grassland area has been reduced to approximately 280 acres. In the Stagecoach EIR SP91-002; TM4974; P91-007; P91-008 that overlay this project area, the grassland was considered an "unmitigable resource." Due to its high biological significance this project area is within the Pre-Approved Mitigation Area (Pama) Multiple Species Conservation Plan (MSCP). Please describe how this project is mitigating a previously determined unmitigable resource that has already been cumulatively and considerably reduced.
3. Please describe how the Alpine County Park project is consistent with CEQA and the County's Biological Mitigation Ordinance in regard to the mitigation of approximately 20 acres of California Native Valley Needle Grassland as well as mitigation measures for Engelmann Oak Woodland, Diegan Coastal Sage Scrub and Riparian habitats.
4. With 2:1 mitigation ratio for California Native Grasslands, please demonstrate how and where approximately 40 acres (or more if required) of equivalent grasslands that will be used as mitigation either onsite or offsite. Please include a map of the habitat areas.
5. As an ancient riverbed containing the remains of a mountain range to the east that no longer exists, with many stones that are not found in the surrounding landscape, the geology underlying the Project area may be unique to San Diego County, if not California. Please evaluate the significance of the riverbed with possible paleontological or fossil presence.
6. As the following will have substantial environmental impacts, please include an economic evaluation and demonstrate the financial (taxpayer) feasibility of the following:
    a. The cost including exact size of leach fields and number of septic tanks that will enable the percolation of x amount of sewage expected to be generated on site. Include percolation rates.

b. If, alternatively, the county is planning on extending the sewer to the site, in addition to the cost, please include a map of the route and describe all cumulative growth impacts that may result.
c. As the site largely occurs on expansive clay soils with stony subsurface, please include a financial evaluation and demonstrate the feasibility of all grading, removal of clay and boulders, rock crushing and disposal of such as needed for the concept plan. Please include less environmentally impactful and less costly alternatives to the concept plan.
d. Please include the costs of replacing clay soils with the expected amount turf that will drain properly as well as enable the growth of grass in those areas proposed for irrigation.

Thank you for considering my concerns,

Yolaine M. Stout

From: VIRGINIA WALKER
To: CEQA, CountyParks
Cc: Alannah Light
Subject: Alpine County Park
Date: Wednesday, March 10, 2021 8:06:17 AM

First of all, I think you need to spend the money on the parks we already have here in Alpine. They are not used because they are not kept up. Why should we want another park that is bigger and will be an eyesore next to our beautiful Wright's Field Preserve when you don't have the money for that to be kept up. It will just become a hangout for homeless and drug dealers. We don't want that here in Alpine. You need to fix up the fields and such that we already have and get people back to using those.

Another reason not to put the park here is because it is still a part of our native grasslands. Native natural grasslands are very hard to find anymore. This piece of property needs to be included into the preserve. This area is a corridor for our wildlife that live around here. Even with the buffer, by only using 25 acres of the 75, this will not prevent the loss of our wildlife. They will go somewhere else as their life will be disturbed. The noise and activity in this area will drive them away. Yes, you have changed the plans to take care of the oaks in this area, but what you plan still won't keep them alive. As you grade around them you will disturb the roots and soil that they have survived in for all these years. They will die.

This piece of land would be great to put, at the entrance area, a parking lot for people to park cars and horse trailers. This doesn't have to be paved, just gravel would do. Put some port a potties there and some picnic tables. That way this could become a destination park for people to walk or ride horses. They would come and explore one of the only large native grassland areas left in our county area. What a pull for birders, animal lovers, and nature hikers. What a stress relief after work. "Come to Wrights Field Preserve to walk and enjoy the native grasslands that used to be everywhere in our county." Wow, you would get a lot of people that way.

Why do you want to destroy something that is so precious in today's world?

You have over the years considered other parcels but have turned them down for different reasons. Most of the reasons are because of some difficulty that you didn't want to deal with. Well the difficulty you are going to deal with here are the people of Alpine. You need to go back to the drawing board on this one. Make it a nature park, connected to Wright's Field. That would solve the problem.

Thanks for reading this if you do.

Virginia Walker

From: VIRGINIA WALKER
To: CEQA, CountyParks
Subject: Alpine Park
Date: Tuesday, April 06, 2021 7:04:20 AM

I really do think that the Board of Supervisors could do a better job for Alpine then to place this park in this area near the Wright's Field Preserve. This active type of park at this location will not only disturb the wildlife of the preserve, this is a wildlife corridor, but disturb the quiet life of the surrounding area. The people of Alpine deserve better from you. We move up here for space, quiet, and nature, not the hustle and bustle of traffic, ball games, parties, all day long. Yes maybe we need pickleball courts and this all wheel course, but let's put those things in a more suitable area. This is not the area for screaming and yelling, but an area for more quiet contemplative activities. Long walks, runs, horseback rides, where one can look for birds and animals. There are not many parks like this around. Not any special grasslands around like this area. Once you start cutting into this land, you will destroy this native grassland and it can never be recovered again. Don't you have a duty as the Board of Supervisors to protect areas like this in our county, not to destroy them!

I really feel that the ball fields we have here in Alpine should be maintained, which they are not, and possibly expanded at the different sites if possible, before any new ones are built. Why not look into if more basketball courts and pickleball courts can be added at any of the school sites. Then start looking elsewhere for places to put these play sites. I know you have been looking for 20 years, but that sounds like a problem of the board. There have been plenty of places, some offers of donated land even, that you have not acted on. So why now all of a sudden do you want to take this pristine grassland and turn it into this enormous park, just so you can pat yourselves on the back and say, "It took us 20 years, but we did it!" That tells me for the past 20 years you have been sitting on your hands and getting nothing done.

I don't feel this is right. I have lived in Alpine for the past 20 years and have never heard anyone complain about not enough ballparks. So let's rethink this idea of destroying this pristine grassland for a park that can be split up and put on pieces of ground that have already been graded, built on, etc. and leave this piece of our heritage alone.

Thank you,

Virginia Walker

From: Louis Russo
To: CEQA, CountyParks
Subject: Alpine County Park
Date: Wednesday, March 10, 2021 12:20:15 PM

This email responds to the request for comments per CEQA for the Alpine County Park to be built in Alpine, CA.

I am a 20-plus year resident of Alpine and a former member of the Alpine Community Planning Group (ACPG). I was also a member of the San Diego Rural Fire District (SDRF) Board and the Grossmont Union High School District (GUHSD) Bond Commission. I wish to state that I was the person who recommended that Jill Blankston investigate the possibility of purchasing this property for a County Park. I wish to also state that I recommend the entire 98 acres be utilized to the maximum extent possible. It is also essential, that Mr. Travis Lyon and Mr. George Barnett, who are members of the Alpine Community Planning Group recuse themselves from any further involvement in this park as they are board members of Back Country Land Trust BCLT) and therefore have a conflict of interest in this matter. In addition, Mr. Lyon is a member of the Alpine Union School District (AUSD) Governing Board, which also causes a conflict of interest with this project. Finally, I must state that I am not an "environmentalist" and supported Mr. Singer's (the original owner) proposed development of this property for estate homes and I also supported his plan to donate a portion of this property to GUHSD for a high school site.

Wright's field, though touted as "environmentally sensitive" is actually no more "environmentally sensitive" than much of Alpine or Cleveland National Forest (CNF), which has nearly 500,000 acres, much abutting Alpine. I view with skepticism any declaration that it is "unique" environmentally. It is a relatively flat piece of land covered with weeds, the same weeds I clear every spring from my property for wildfire abetment. If, indeed, there is a particular plant that needs "protection" then that small area can be protected while the rest is used. Note that Joan McQueen Middle School (JMMS) classes conduct "nature walks" through it and the cross country teams run on it, not to mention the kids who walk to/from school, etc. Having an active park on a portion certainly isn't going to hurt any flora or fauna on it.

At one time a "wall" was declared ancient and needed to be protected. The same professor from San Diego State University who declared it as such has been consistently overruled by State experts on numerous declarations I am aware of.

For my entire time on the ACPG, there was a consistent request for parks by the community. These came from parents in the main, who wanted to take their preschool children to a park during the school day to those who wanted to walk their dogs or ride their horses or have a picnic. Tom Dyke offered the property that currently has the SDGE yard on it for a park. In fact, County Parks came up with a plan for this area. There were two problems with it. First, this parcel was created when Interstate 8 was blasted through the granite and the material was dumped into a depression. There was never any idea to use this land later so proper compaction techniques were not used. (In fact, you can see issues on Interstate 8 today being addressed by CalTrans.) Also, the fuel tanks from the gas station to the east have leaked and contaminated portions of it, which prevent a Sheriff Station from being built there also. When Albertson's was built, County Parks once again created a plan for the portion that Albertson's wasn't going to use and was going to donate. The problem here, besides being small, is that it

looked into people's bedroom windows. I could go on and on, but you get the idea. The parcels being floated as possibilities all had fatal flaws. Throughout this entire time, the individuals listed above kept telling the community that "there's no land in Alpine for a park", knowing full well there was, because THEY were trying to buy it. Finally, through various sources, I learned that this parcel was still available and made the recommendation to the County.

Let me address the issues:

Fire Safety: As a former member of the SDRF Board I must state that County Park's plan will make this parcel MORE safe. Note that on the other side of BCLT's holding is JMMS. It is a wildfire evacuation site and this park can be also, especially for large animals. The design of the park mitigates the BBQ's, etc. fire potential. Also, it enables fire fighting equipment access where only Brush Rigs could currently traverse.

Road Safety: South Grade is no more dangerous than any similar section in Alpine or East County. The fatal accidents there were not atypical. As a side note, the 19 year old girl who was recently hit by a hit and run driver was walking well off the road near Albertsons. As an aside, she is my daughter's best friend and I am furious that those opposed to this project would attempt to use her misfortune to their advantage. Also it seems disingenuous that parents have been begging for sidewalks to JMMS from town to no avail for decades yet somehow those opposed want the lack of sidewalks to be a show-stopper for the park.

Water: The individuals above got the former Supervisor, Jacob, to give AUSD the nearly $1 million (and now $1.2 million) of PLDO funds to refurbish the PE fields at JMMS. These are going to be grass fields and water is plentiful there via a well. There is no doubt that there is plenty for the Park. I am also aware of the County's ability to limit water usage through landscaping modifications, etc.

Light/Noise Pollution: This is especially grating in that the same people raising this issue here had loss of hearing when AUSD planned to place lights/have youth sports leagues on the refurbished fields being paid for with PLDO monies and those living next to those fields raised the issue. There is no doubt that any light/noise pollution at the park will be less especially considering the traffic noise and daylight only hours.

In short, those who are opposed to the park are so inclined for their own personal reasons, primarily that they want it for their environmental organization or want it for their own "greenbelt", and they are throwing everything they can at the wall to see if anything will stick. Build the park as your plan shows, and consider INCREASING the area utilized. 98 acres is awesome and in the future can continue to serve the recreation needs of Alpine...actively!

You may call or email me for any questions/information.

Sincerely,

Louis Russo
1524 Montecito Vista
Alpine, CA 91901

619 300-0866

P.S. I've learned over the years with BCLT that it is always best to ask for the proof, e.g. if they say "this plant is endangered", etc., get proof.

From: susanem
To: Bradley, Lorrie
Subject: please inform where the completed enrollment report can be obtained for review. thank you. susan sweeney
Date: Tuesday, March 09, 2021 10:21:02 PM

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susanem@cox.net

Sent from my Verizon, Samsung Galaxy smartphone

Kyle Ogle and Dominique Norton

2623 Calle de Compadres

Alpine, CA 91901

April 7, 2021

County of San Diego

Department of Parks and Recreation

Attn: Alpine County Park Environmental Review

5500 Overland Avenue, Suite 410

San Diego, CA 92123

By email to CountyParksCEQA@sdcounty.ca.gov and lorrie.bradley@sdcounty.ca.gov

RE: Notice of Preparation of a Draft Environmental Impact Report on the Alpine County Park Project

Dear Ms. Bradley,

Thank you for the opportunity to provide information for the Notice of Preparation ("NOP") of the Environmental Impact Report ("EIR") on the Alpine County Park Project ("Project").

Transportation and traffic

The proposed park currently includes a new four-way stop feeding all traffic into the park at the intersection of Calle de Compadres and South Grade Road, exactly where our home sits. The idling cars at this intersection will increase congestion, noise and air pollution. South Grade Road is an extremely dangerous two-lane unimproved country road. There have been several people who have lost their lives on this stretch of South Grade Road of which one death occurred directly abutting my property.

The County states that there will not be a parking fee to use the proposed park at this time, but there is no guarantee of the future. Parking onsite would help to reduce street parking, congestion, accidents and fatalities. If a parking fee is instituted, like many other County parks, patrons will find other locations to park their vehicles to avoid paying the fee. In this situation, it

will remain the same with patrons parking on South Grade Road and Calle De Compadres exasperating the dire mobility element.

In addition, there is no safe way for young people to get to access the park without either traveling from the town center via South Grade Road, which in most areas does not have a shoulder and has many potentially fatal blind spots, or via Wright's Field Ecological Preserve.

This concern needs to be analyzed in the project EIR. The impacts should be avoided or, at worst, mitigated below the level of significance.

Noise pollution
We chose to live here. We did not choose to live next to heavy machinery needed for construction nor did we choose to live next to constant traffic, idling cars at the proposed four-way stop, increased number of people's voices, endless dogs barking, car alarms going off, amplified music at events held at the pavilion, wheels at the bike and skate park, and all conducted over an abundance of additional concrete needed to complete the park. County Parks' current solution is to build a berm at some unknown height to mitigate noise. The impacts should be avoided or, at worst, mitigated below the level of significance.

Water
Our world is in a climate crisis and water is a finite resource. The proposed park includes water-guzzling manicured turf and landscaping. As new property owners, we are considering when to drill a well for our use and would then share an aquifer with the park. We are concerned that we will lose our well water if the park starts pumping. The impacts should be avoided or, at worst, mitigated below the level of significance.

Septic/Sewer
The NOP states sewer or septic would be used to accommodate public bathrooms. There is currently no municipal sewer tie-in close to this property. Septic tanks and leach fields could affect neighboring properties if it were to pollute our groundwater. This concern needs to be analyzed in the project EIR. The impacts should be avoided or, at worst, mitigated below the level of significance.

Wildfire
Alpine is a in a high fire risk area of the County. As a property owner, it is hard to obtain fire insurance as such. This proposed park would increase the fire risk to all abutting neighbors thus making it even more difficult to obtain/keep insurance and worse than that threaten all of our properties with the increased use of this space. The impacts should be avoided or, at worst, mitigated below the level of significance.

Aesthetics
We moved to Alpine for the quiet rural community, and specifically fell in love with this home due to its amazing views and sunsets. We are deeply concerned about how having a bunch of concrete and berms across from our home will affect our view and hence the resale value of our property. This concern needs to be analyzed in the project EIR. The impacts should be avoided or, at worst, mitigated below the level of significance.

Light pollution
Alpine is a dark sky town. The current proposal includes safety lighting along with light for the volunteer housing. When asked, County Parks stated that ball field lighting is not currently included in this proposal but if that is something Alpine wants it can be incorporated. There will be motion sensor lights that will undoubtedly go off all night long as a result of the active wildlife on the property (owls, coyotes, mountain lions, bobcats, etc). This light will destroy the dark sky. The impacts should be avoided or, at worst, mitigated below the level of significance.

Project Alternative
Please include a project alternative with a smaller, nature-focused, minimally developed park that has no impacts to the biological, cultural, and other resources of the project site, Wright's Field Ecological Preserve, and neighboring properties. Focus on making its upkeep and maintenance financially sustainable for the community. Make its construction, maintenance, and rebuilding carbon neutral and environmentally sustainable, to meet federal, state, and county goals. The Alpine community already has a number of indifferently maintained, lightly-used parks designed to provide many of the amenities this project seeks to build. Why add more?

Please analyze all of these potential impacts to transportation and traffic, noise pollution, water, septic/sewer, wildfire, aesthetics, and light pollution and avoid the significant ones. Please also make sure that I receive all updates and meeting notices on this project, at dqnorton@gmail.com and the mailing address above. Thank you for taking my comments.

Sincerely,

Kyle Ogle and Dominique Norton

From: joyce nygaard
To: CEQA, CountyParks
Subject: Alpine Park CEQA comments
Date: Wednesday, April 07, 2021 3:55:54 PM

Hello,
Thank you for opportunity to express my concerns about the proposed Alpine County Park.

Noise

Many of the amenities planned for the Alpine County Park are noise generating. These will be stationary and will be generated 7 days a week from dawn to dusk. The Alpine Community Plan Update states that 75 CNEL is acceptable for land uses. It further states that the County will "maintain the tranquility of residential neighborhoods by reducing potential noise pollution." Their goal is to "encourage land use and circulation patterns that will minimize noise in residential neighborhoods and sensitive land use areas." This proposed park has homes surrounding it on three sides and sensitive habitat on the other.
Noise levels from skateparks can be 64-96 dB, depending on materials used and tricks done by riders. Basketballs can generate 75-85 dB. Bats hitting balls can range from 50-120 dB. Added to that will be the sound of dogs barking and the loud pop of a pickleball on the paddle and asphalt. Sound travels very well in this area. People speaking at a normal conversational level (60dB) can be heard at homes on the surrounding hills and neighborhoods. Noise analysis needs to take into consideration how the added noise pollution generated by these proposed amenities will be heard by residential neighbors and those trying to enjoy the adjacent sensitive habitat.

Greenhouse Gas Emissions

With all of the amenities currently included in The Alpine County Park it will be a destination park. People will drive there from surrounding areas to visit the bike and skate parks in particular. There is also no safe access to this park by foot, bike, or skateboard and there is no public transportation available. It will mainly be reachable by automobiles. The County estimates the park will attract thousands of visitors per week. The increase in greenhouse gas emissions from increased vehicle traffic to and from the Alpine County Park needs to be studied.

Traffic

The County is anticipating thousands of vehicle trips to the proposed park weekly. These vehicles will have to travel on South Grade Road. In some sections, South Grade already has a very poor level of service. The road cannot easily be straightened, widened or have sidewalks added. Doing so would likely require the use of eminent domain. There is no public transportation to the proposed park property. Many homes have driveways that are directly off of South Grade. At least 3 people have died on this stretch of South Grade in the past few years. More cars will put more people at risk. Serious consideration of traffic issues and how

they can be mitigated and a cost/benefit analysis are needed.

Wildfire

I am concerned about having BBQ pits with open flames and hot ashes in the proposed County Park. This area of Alpine has burned in the past, most recently during the West Fire in 2018. The County's plan is to cover the grills with bags during high wind warnings. Even when there is not a high wind warning, embers can blow to trees or other areas of the park and surrounding homes and cause a wildfire.

Utilities/Service systems

The County seems to be still debating whether to use sewer or septic for this site. All surrounding residential areas are on septic. This property has failed percolation tests many times in the past. This park is not close to sewer lines. What will the cost be to connect to sewer and who will pay for it?

These are just a few of my concerns.

Thank you,
Joyce Magruder Nygaard
1434 Ramsey Rd.
Alpine, CA 91901
619-599-6242

From: Jonah Gula
To: CEQA, CountyParks
Subject: Alpine County Park
Date: Tuesday, April 06, 2021 2:26:21 PM

Hello,
I would like to express the following environmental concerns about DPR's proposed plan for the County Park in Alpine:

- Besides the listed threatened species that occur on the property (which seem to have only been of concern thus far), the following California Species of Special Concern can be found on the property:
  - Crouch's Bumble Bee
  - Western Spadefoot
  - Coastal Whiptail
  - San Diego Legless Lizard
  - Red Diamond Rattlesnake
  - Grasshopper Sparrow

- Additionally, during winter the following species are found on the property, all of which have declined across their distribution in the United States:
  - Vesper Sparrow
  - White-crowned Sparrow
  - Lark Sparrow
  - Savannah Sparrow

- The environmental significance of the proposed park site goes beyond state or federally listed species. This site represents a fragment of the small amount of remaining native grassland in San Diego, and the construction of the park as is will not only impact listed species. Therefore, DPR must purpose to do comprehensive biological surveys of mammals, birds, reptiles, amphibians, insects, and plants. Many of the species that can be found on the site have declined in San Diego County because of projects like this park, which have slowly chipped away at the edges of remaining natural habitat.

- The impacts of the increased use of adjacent Wright's Field have yet to be addressed by any stakeholders. The overflow effects of foot, bicycle, and equine travel from the park into Wright's Field will have meaningful impacts on vegetation and wildlife, not to mention the potential increase in dog walking (on and off leash). Mounting research has demonstrated the negative impact of dogs on wildlife and this consideration is important in DPR's environmental assessment.

- The fragmentation of the grassland that this park will cause will have implications for

wildlife and plants that remain in the undeveloped edges of the county property. Negative edge effects are a well-studied subject in wildlife ecology and must be addressed by DPR given the sensitivity of the habitat community.

- Alpine's historic upland habitat resembled the proposed park site and adjacent Wright's Field, but urban sprawl has left this remaining habitat as the only remnant of what the area used to be. Thus, DPR must consider how this park will diminish the last of Alpine's natural heritage.

- DPR must do no less comprehensive an impact assessment than that found in the previous assessments for the proposed Stagecoach Ranch housing development decades ago. Specifically, details of the assessment can be found in the Planning and Development document archive under Record ID PDS2011-39107714280 and PDS20103100-4974. If development decades ago was considered too detrimental to this sensitive environment, then it will be even more so today given that this habitat is even more threatened now than then.

- The projected timeline set forth by DPR is insufficient for thorough biological assessment given the time required to properly study wildlife and plant occurrence and abundance across each season of the year. By limiting surveys to a short segment of the year, DPR will ignore the reality of the location's seasonal ecology. For example, unless surveys are conducted during the rains, Western Spadefoots will go undetected. The rushed timeline for the project will lead to inappropriate conclusions and sloppy science.

Thank you,
Jonah Gula

Anne Falasco Norton
2457 Avenida Canora
Alpine, CA 91901

April 2, 2021

County of San Diego
Department of Parks and Recreation
5500 Overland Avenue, Suite 410
San Diego, CA 92123
CountyParksCEQA@sdcounty.ca.gov
lorrie.bradley@sdcounty.ca.gov

Attn: Alpine County Park Environmental Review

Dear Ms. Bradley,

I appreciate the opportunity to provide information for the Notice of Preparation (NOP) of the Environmental Impact Report (EIR) on the Alpine County Park Project (Project).

This proposed park as it is presently planned will forever alter and change the character and ambiance of its bordering neighborhoods. Our home of over 30 years is part of Palo Verde Ranch and abuts South Grade Road, separated only by one residence. We have an elevated view of the proposed Project. Instead of the peaceful atmospheric views we now enjoy, the land will be defaced with man-made activities, permanently eliminating the valuable natural resource that it is today. these impacts should be analyzed in the EIR. These impacts should be avoided or mitigated below the level of significance.

Direct impacts to our neighbors and ourselves include increased noise for the activities within the park and noise generated from the drastic increase of traffic to reach this destination park. Barking from dogs, constant sounds of skateboards against hard concrete and the tires creating dust from the bike skills area will be a constant annoyance to the neighbors and certain deterrents to the wildlife who make this area a safe animal pathway. Noise from all the activities will resound throughout the neighborhood directly impacting the area…non-stop…til dusk due us part… These numerous impacts should be analyzed in the EIR. These impacts should be avoided or mitigated below the level of significance.

Dog-transmitted diseases, some of them airborne, and the stench of poo and urine will permeate the dog park grounds adding to the risks of disease and serious dog fights typical at such sites. These numerous impacts should be analyzed in the EIR. These impacts should be avoided or mitigated below the level of significance.

We pride ourselves in being part of a Dark Sky zone. People throughout the county come to Alpine to view stellar phenomena. Having a permanent on-site trailer/home generating light and the additional lighting within the park to deter crime will totally end this treasure. God forbid when the County allows lighted ballparks….total destruction. These numerous impacts should be analyzed in the EIR. These impacts should be avoided or mitigated below the level of significance.

We have a working well which may be directly impacted by the draw of water use needed at the Project. Chemicals used to treat the lawns can cause air-borne allergies and affect ground water contamination. These numerous impacts should be analyzed in the EIR. These impacts should be avoided or mitigated below the level of significance.

The Project will draw the need for more police protection from our Sheriff Substation which spills over with increased crime that directly affects the Project's neighbors who presently see very little crime. This impact should be analyzed in the EIR. These impacts should be avoided or mitigated below the level of significance.

Traffic along South Grade will increase substantially with no reasonable mitigation offered. With this comes the increase of air pollution and safety issues. The parking allotment within the park indicates the county's plans for a high volume park. Overflow parking along South Grade and into the county-owned residential streets next to the park will be inundated during the "big events" that will be scheduled at the Project. Parking will remain a high concern because inevitably, parking within the project will have a price tag and Alpiners will not pay the price (nor should they). Therefore, we will continue to see the residents of Alpine park along South Grade and the nearby residential streets. All of this points to a heavily increased use of and heavily increase of danger and safety on South Grade Road which was not built for such volume. These numerous impacts should be analyzed in the EIR. These impacts should be avoided or mitigated below the level of significance.

The change of topography in order to achieve all the activities will drastically be altered when a "berm" will be constructed that will in effect halt all views of the park from the road. One of the beautiful and calming aspects of the existing property is that one can drive past the very open fields and with just glancing, obtain the sense of outdoors. These numerous impacts should be analyzed in the EIR. These impacts should be avoided or mitigated below the level of significance.

Presently, the Project effectively eliminates all access to Wright's Field (WF). One will be forced to travel through the Project in order to enter WF. By doing this, the County just added another layer of hindrance, effectively deterring its own residents from access to this wonderful gem. The other access area to the park is via a private road abutting Joan McQueen Middle School. No one is allowed to park on this private road and no designated spots exist to accommodate WF enthusiasts at Joan McQueen. The other "access" is at the end of Olivewood Lane with no adequate public parking. These numerous impacts should be analyzed in the EIR. These impacts should be avoided or mitigated below the level of significance.

This project will hands-down substantially degrade the quality of the environment for all Alpine residents but more importantly: our dwindling wildlife habitat. It will further destroy a huge chunk of one of the last remaining grasslands in our county and State. These numerous impacts should be analyzed in the EIR. These impacts should be avoided or mitigated below the level of significance.

In previous statements to the County and to the Alpine Community Planning Group (ACPG) and in published Letters of the Editor of the Alpine Sun I have made it quite clear that ideally the Project's land use should remain passive. Where the land is presently disturbed, only that area should be designed for parking and minimal facilities. The active portions of the Project should be removed and other locations should be identified. This alternative should be analyzed in the EIR.

In addition, at last week's ACPG meeting I offered an alternative location for many of the Project's activities that are not suitable to the Project's location: Alpine Elementary School (AES) in the heart of Alpine. It is an historical site sitting idle and empty. This site could be the perfect fit with regards to providing the activities in the park (the skateboard and bike parks, the playing fields, the community garden and the dog park) that ought to be clustered within the higher populated area of Alpine. This higher populated area is our village center. If designed properly, AES could become a stalwart example of incorporating historical value with the present needs of our community. AES already has the infrastructure. It has playing fields. It has reasonable off-street parking. It has existing electrical, water and sewage hookups. It addresses the traffic flow. Fields could be lighted without causing light pollution. Situated at the school, in the heart of town, the bike, skate and dog parks would not cause noise pollution. This is the location where these types of activities belong and are best served. This alternative should be analyzed in the EIR.

Another alternative park site in the heart of Alpine is the old Alpine School District's offices which also has similar amenities that are suitable for the active portion of the Project. This alternative should be analyzed in the EIR.

It is a great disappointment to have to continue to address to the County that this property is not suitable because of the magnitude of the Project. The County should be the steward of our precious environment. Instead the County leaves the undeniable impression that paving over sensitive and diminishing lands to build more ball fields and whimsical structures to satisfy the short-sighted needs of the public is of utmost importance. This Project continues with the "Slash and Burn" attitude, denuding what is left of our natural resources.

All of my above concerns with the numerous impacts should be analyzed in the EIR. These impacts should be avoided or mitigated below the level of significance. The Project alternatives should be given serious study and review.

Sincerely,

Annie Norton