ECOLOGICAL IMPACTS OF RECREATION ON CONSERVED LANDS WITH A FOCUS ON MOUNTAIN BIKING – A PRIMER

NOVEMBER 2018 Libby Lucas

PREPARED FOR THE

WILDLIFE AND HABITAT CONSERVATION COALITION'S RECREATION COMMITTEE

Carlsbad Highlands Ecological Reserve

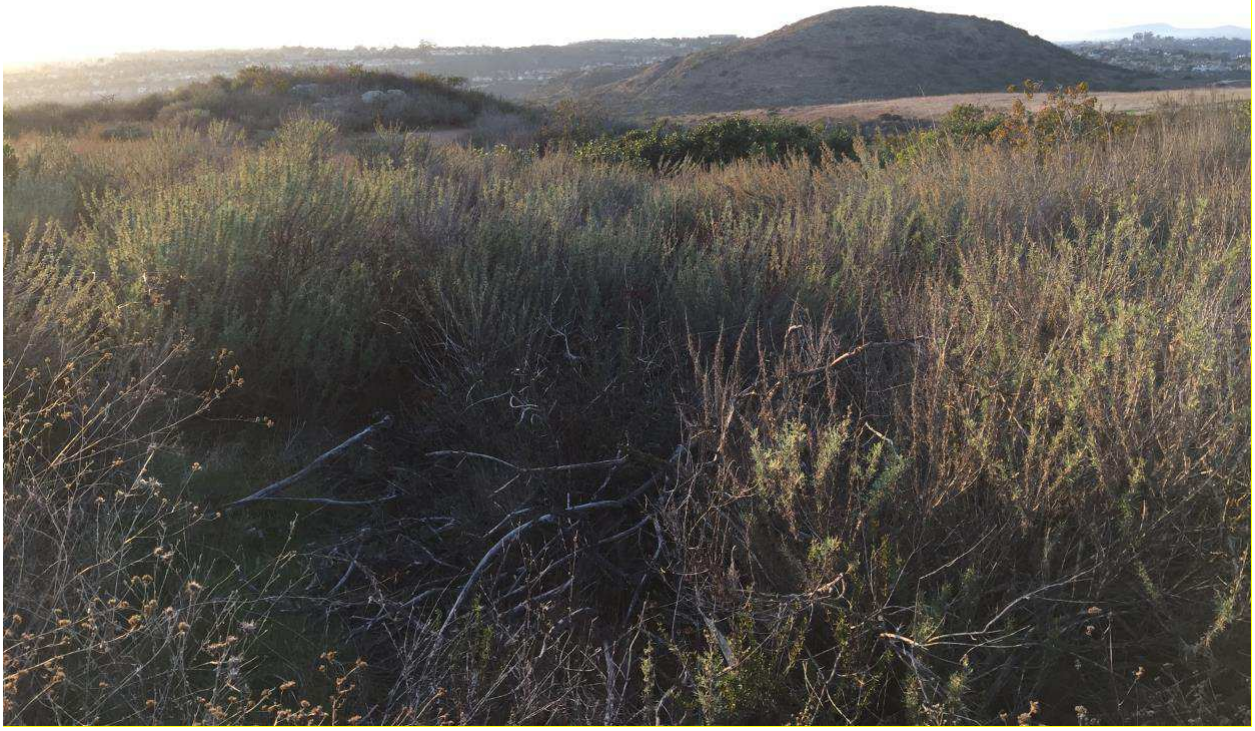

Table of Contents

Click on page # to go there. To return to TOC, use option+command+G (i.e., ⌥⌘ G).

Preface

The purpose of this Primer is twofold. First, it provides information from the reviewed literature about recreation-related impacts on wildlife, focusing on the impacts from the creation and use of unauthorized mountain biking trails. Second, it suggests Priorities for consideration to address the challenge of these unauthorized activities and of proposed trails and trail systems of concern. For a breakdown of the articles reviewed for this Primer, refer to Appendix I.

The impetus for the literature review and this Primer is the concern about the ecological impacts in San Diego County from (1) the rapid and widespread proliferation and use of unauthorized mountain biking trails and technical trail features on conserved lands[1] and (2) proposed trail plans whose implementation would exacerbate the already fragmented condition of many of the conserved lands. While the focus of this Primer is those ecological impacts, it also considers other types of non-consumptive (and, for the most part, non-motorized) outdoor recreation on conserved lands. This is in part because there is a dearth of peer-reviewed literature solely about the ecological impacts of mountain biking.[2] In fact, despite the prevalent and ever-increasing recreational use of conserved lands, and the growing evidence that a wide variety of recreational activities can cause negative impacts on wildlife, such impacts are still a relatively unknown and low-profile topic in the conservation science literature (Larson, Reed, Merenlender, & Crooks, 2016), though there is a wealth of peer-reviewed articles available on other types of anthropogenic ecological stressors.[3] Although much research has been done on the direct and indirect impacts of human activity on mammals, birds, reptiles, and vegetation, comparatively little has reached the peer-reviewed literature, especially with respect to long-term impacts of human activity (Burger, 2012).

This Primer's emphasis is on recreation-related impacts on wildlife[4] rather than on vegetation and habitat or abiotic[5] impacts because (a) excepting edaphic microorganisms, much evidence of impacts on vegetation, habitat, and abiotic resources is readily visible on conserved lands, particularly in urbanized settings, (b) the impacts of trampling on vegetation and soil are among the most commonly and systematically researched topics in recreation ecology (Monz, Pickering, & Hadwen, 2013),[6] and (c) the level of common knowledge about recreation-related impacts on wildlife is lower than about impacts on vegetation and abiotic resources. Hence, there is a greater need here to provide information about the former.

This Primer's focus on mountain biking is not intended as an indictment on this activity's ecological impacts over those of other recreational activities. Considering the articles reviewed collectively, it's apparent that no defensible overarching statements can be made comparing the relative ecological impacts among recreational activities on conserved lands. This is in large part because studies' reported outcomes are shaped as much by study methodology (which varies widely among studies), a multitude of variables not controlled for, and statistical analyses as they are by the empirical observations underlying the analyses. Further, "concerns regarding the interaction between mountain bikers and wildlife are difficult to generalize on a national level – potential threats to critical species must be assessed at a local level and on a case-by-case basis" (Quinn & Chernoff, 2010, p. 24). The exceptional variable is the distance that mountain bikers travel – it is farther than hikers per unit time, and therefore bikers generally affect larger areas of habitat and the wildlife therein; among the reviewed articles, hiking and mounting biking are the two most compared recreational activities.

---

1 The most egregious example in San Diego County the author is aware of is the approximately 50 miles of unauthorized trails created on the 430-acre Carlsbad Highlands Ecological Reserve in the City of Carlsbad (Keltz, 2018).

2 In a systematic review of 274 articles in the scientific literature through the year 2015, Larson et al. found that hiking was studied much more often than any other recreational activity (27.5% of articles) (Larson et al., 2016).

3 Although the term 'impact' is, by definition, value neutral, public agency staff and concerned citizens alike generally use the term 'environmental impact' to refer to negative effects or outcomes (Quinn & Chernoff, 2010). Here, the phrase "ecological impacts" encompasses all the impacts that the articles discuss, both biotic and abiotic.

4 "Wildlife" here means all wild animals, birds, fish, amphibians, reptiles, and insects.

5 Examples of abiotic impacts include soil erosion, altered drainage patterns, water pollution, incised substrate, and cut slopes, though effects on organisms from these impacts are biotic.

6 Recreation ecology is commonly defined as the study of the impacts of outdoor recreation and nature-based tourism activities in natural or semi-natural environments (Liddle 1997; Hammitt and Cole 1998)" (Monz et al. 2013, p. 441).

Introduction

"Of all US states, California has the greatest number of listed species threatened by recreation, in part because the threat of recreation is most frequently associated with urbanization [= habitat loss], another important cause of endangerment (Czech et al. 2000)" (Reed, Larson, Crooks, Merenlender, 2014, p. 3).[7] Conserving lands is considered to be the major method for conserving biodiversity worldwide (Worboys et al., 2005 & Lockwood et al. 2006, as cited in Pickering, 2010a).[8] Yet, these conserved lands[9] often serve a dual purpose of "preserving biodiversity and providing nature-based recreation opportunities for millions of people. This dual mandate guides the management of the majority of the world's protected areas, but there is growing evidence that quiet, nonconsumptive recreation may not be compatible with biodiversity protection" (Reed & Merenlender, 2008, p. 146).

An example of conserved lands local to southern California are the lands conserved pursuant to Natural Community Conservation Plan/Habitat Conservation Plan (NCCP/HCP) programs.[10] The terms and conditions under which the NCCP/HCP preserved lands are conserved "establish that public access is not only a permitted, but in some cases [an] encouraged use of the land" (Burger 2012, p. 6). For example, the Implementation Agreement (IA) for the County of Orange Central and Coastal NCCP/HCP Habitat Management Program (OC NCCP/HCP)[11] lists recreation as one of four areas requiring management plans under the OC NCCP/HCP[12] (1996, p. 54). And, "Conservation Easement Deeds over 11,000 acres of land owned by Orange County Parks state unequivocally that 'regular and substantial public access' is a conservation value of equal importance to natural resources" (Burger 2012, p. 6).

Wildlife species exhibit a variety of responses to human presence, ranging from attraction to habituation to avoidance (Whittaker & Knight, 1998 – refer to text box on page 11), with the majority of documented responses being negative (Patten & Burger, 2018). Any form of [outdoor] recreational activity involves some degree of environmental impact on the soils, vegetation, wildlife, and water of the landscape in which it occurs (Quinn & Chernoff, 2010). Outdoor recreation has the potential to disturb wildlife, resulting in energetic costs, impacts to animals' behavior and fitness, and avoidance of otherwise suitable habitat (Taylor & Knight, 2003; George & Crooks 2006). This loss, in effect, of

---

7 "More than 85% of coastal sage scrub habitat has already been lost to urban and sub-urban development (Westman 1981; Hobbs & Mooney 1998)" (Markovchick-Nicholls, Regan, Deutschman, Widyanata, Martin, Noreke, & Hunt, 2007, p. 3). The loss of coastal sage scrub has continued.

8 The formatting of some of the citations in this paper may not comply with the APA or MLA.

9 As used in this Primer, conserved lands are lands that are protected to ensure that the biological resources they support persist and thrive. While they include public and private lands (the latter typically managed by an entity like the Center for Natural Lands Management), this Primer's focus is local, state, and federal public lands. These lands are needed for the perpetuation of sensitive plant communities and species, including those listed under the California and/or Federal Endangered Species Acts or California's Native Plant Protection Act, while allowing development (including trail systems) to proceed within the parameters of the processes by which the lands are conserved. Sometimes, those parameters prohibit certain human activities on the lands.

10 "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 the NCCP Permit, [California Department of Fish and Wildlife] can authorize take of certain state listed species and other species of concern, subject to the terms of coverage under the NCCP" (California Department of Fish and Wildlife, 2015, Volume 1 p. 7-20). An HCP is the federal counterpart to an NCCP; the U.S. Fish and Wildlife Service prepares HCPs and issues HCP permits. Both the multi-year preparation of the NCCP/HCP Plans and their long-term implementation require monumental effort.

11 The OC NCCP/HCP was the first such plan completed. This Program is the subject of four references cited in this Primer - the 2006 George & Crooks article, the 2012 and 2017 LAG reports, and the 2018 Patten et al. article.

12 "Programs for implementing the NCCP/HCP policies shall be further defined in the management plans referenced in the NCCP/HCP... The management plans identified in the NCCP/HCP are as follows:
(1) Fire Management; (2) Grazing; (3) Recreation; (4) Restoration/Enhancement."

otherwise suitable habitat may be sufficient to reduce the carrying capacity of some public lands for wildlife (Light & Weaver, 1973, & Stalmaster, 1983, as cited in Taylor & Knight, 2003).

For sensitive species, even a few visitors can lead to habitat degradation or loss. Uses that may result in habitat degradation or loss include people recreating in nature… outside of established transport corridors (CDFW, 2016). "The potential ecological impacts of these activities are diverse, including direct kill of species, soil compaction, erosion, pollution/contamination and water, light, and noise pollution" (CDFW, 2016, page 11).

With regard to mountain biking, its ecological impacts are "growing with the popularity of the activity" (Weiss, Brummer, & Pufal, 2016, p. 326).

Recreation-Related Ecological Impacts

Comparing Differences of Ecological Impacts Among Recreational Activities

If they consider the matter at all, recreationists tend to blame other user groups for negative impacts to wildlife rather than holding members of their own recreational user group accountable (Taylor & Knight, 2003). However, it is clear from the literature that most outdoor recreation on conserved lands, particularly in more urbanized areas, has a negative correlation with wildlife detection. So, the differences among recreational user groups in their impacts on wildlife are less important than the negative association for wildlife of human presence, irrespective of type (Burger 2012; Patten & Burger, 2018).

With respect to conserved lands, it seems that the only situation warranting the comparison of the ecological impacts among recreational activities is when deciding which activities (if any) might be compatible with the conservation purposes of a given landscape. Even in this context, "it is difficult to make generalizations about the effects of recreation on wildlife" (Monz et al., 2013, p. 444) and to arrive at an assessment that will be valid in the long term because the assessment may overlook other impacts that require consideration and the results of any comparison conducted can vary significantly depending on the impacts under, and the variables taken into, consideration.

For example, research considering the recreation-related impacts on soil and terrain along established trails showed that horses (with riders) cause more damage than bikers as they dislodge more material and use wider trails (Wilson & Seney 1994 as cited in Davies & Newsome, 2009; White, Waskey, Brodehl, & Foti, 2006). Conversely, research comparing the responses of elk exposed to ATVs, mountain biking, hiking, and horseback riding showed that, overall, horseback riding caused the lowest travel response in elk (travel is a less critical behavior than feeding and resting) (Naylor, Wisdom, & Anthony, 2009).[13] That is, horseback riding can be the most or least impactful activity compared to other activities depending on what is being studied.

Study results are not necessarily consistent when one might expect consistency if considering only the types of target wildlife and the anthropogenic disturbances being tested, as illustrated below in studies about ungulate response to vehicles, bikers, hikers, and horses (with riders); underscoring is added for easy comparison.

13 Burger (2012 and 2017) also concluded that, while wildlife exhibited strong avoidance behavior to all user types, pedestrians (all human activity on foot) had the strongest negative association with wildlife; bikes and vehicles were close behind in rank, followed by dogs and horses (with riders) which had the least negative effect.

a. "Elk travel time was highest during ATV exposure, followed by exposure to mountain biking, hiking, and horseback riding" (Naylor et al. 2009, p. 328).
b. "Hikers caused the most severe responses in desert bighorn sheep (animals fled in 61% of encounters), followed by vehicles (17% fled) and mountain bikers (6% fled), apparently because hikers were more likely to be in unpredictable locations and often directly approached sheep" (Papouchis, Singer, & Sloan, 2001, as abstracted in Reed, 2014, p. 91).
c. "Linear regression models indicated that there was little difference in alert distance, flight distance, or distance moved between hiking and biking for [bison, pronghorn, and mule deer], with the exception of mule deer flight distance" (Taylor & Knight 2013, p. 958).
d. "Among non-motorized activities, bikers and equestrians had no effect on elk behaviour [sic] likely because they are more predictable and rarely leave roads and trails. In contrast, hikers evoked an increase of proportion of time travelling in elk" (Ciuti, Northrup, Muhly, Simi, Musiani, Pitt, & Boyce, 2012, p. 11).[14]

These examples reflect an aspect of ecological research that makes the research so complex – variables, a major, if not the main, reason for the differing conclusions among the cited articles. For more on the subject of variables, refer to Appendix II.

Note that the absence of differences among recreational activities' ecological impacts does not mean that there are no impacts. Similar levels of impact can be benign or significant. For example, Lathrop (2003, an apparent biking advocate) explains that Taylor (as cited in Lathrop, 2003)[15] "found **no** difference between mountain bikers [and] hikers in flushing response" (emphasis added) among bison, pronghorn antelope, and mule deer, and that "for both user groups, alert distance and flushing distance did not significantly vary." This is close to consistent with the conclusions in Taylor and Knight (2003),[16] but there **were** impacts - all three species exhibited a 70% probability of flushing from on-trail recreationists within 100 meters from trails and mule deer showed a 96% probability of flushing within 100 meters of recreationists located off trails. Furthermore, there was little evidence of habituation 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 in fact used areas that were significantly farther from trails than they had prior to the start of recreational use (Fairbanks & Tullous, 2002, as cited in Taylor & Knight, 2003).[17]

A List of Some Recreation-Related Ecological Impacts

As bulleted below, there are at least three overarching themes to consider when reading about any anthropogenic impacts on wildlife.

A. The absence of detected impacts does not equate to no impacts. For example, Steven, Pickering, and Castley (2011) explain that possible reasons for original research finding no recreation-related

14 This article provides insufficient information for the reader to understand how the observers, from their parked vehicles always greater than 500 meters from the elk herd, observed the elk responding to trail users, whether hikers, bikers, equestrians, or ATV users. Also, the assumption that bikers rarely leave the roads and trails is not true for urbanized open space.

15 The author did not obtain Taylor's 2002 Master's Thesis, which is the primary source Lathrop used, so she does not know exactly how it reported the study outcomes.

16 While Lathrop wrote "**no** difference," Taylor and Knight (2003) wrote "**little** difference between hiking and biking in alert distance, flight distance, or distance moved for the bison, pronghorn antelope, mule deer" and noted an exception of mule deer flight distance, an exception Lathrop did not note (emphases added).

17 To the credit of the International Mountain Biking Association (IMBA), the article by Marion and Wimpey (2007) included in IMBA's 2007 book titled *Managing Mountain Biking: IMBA's Guide to Providing Great Riding* acknowledges the impacts described here with the exception of the observed lack of habituation.

impacts on birds include that:

a. "there was no effect of the specific [recreational] activities on the traits examined in the bird species studied" (p. 2291);
b. "there may have been a negative effect but it was not detected due to methodological issues such as the number of replicates used compared to the amount of variation in the traits measured" (i.e., there was a significant effect, but the research required more statistical power to detect a significant result (Zar 1996 as cited in Steven et al. 2011)) (p. 2291); and/or
c. "the response variable examined (behaviour versus physiology) may not have revealed the actual response of the bird or its longer term population level effects" (p. 2291).

B. It is easy to misinterpret the reasons for and implications of observed responses. For example, in a controlled study, Beale and Monaghan (2004) made the following observations of and conclusions about the behavioral responses of a shorebird (ruddy turnstones – *Arenia interpres*) to human disturbance [consistent with Gill et al.'s (2001) hypothesis - refer to footnote 25 in this Primer].
   a. Birds in better condition (i.e., supplemented with food) flushed at a greater distance (i.e., sooner) from the disturbance than control birds (i.e., not supplemented with food) and searched for predators more frequently.
   b. "[Birds] responding most were actually the least likely to suffer any fitness consequences associated with such disturbance: the opposite result from what is assumed when behaviour is used as an index of disturbance effects" (p. 1068).
   c. More intuitively, individuals that had the most to lose by flushing, or otherwise changing their behavior in a manner that reduced feeding time, showed the least behavioural response.[18]
   d. "It cannot be assumed that the most responsive animals are the most vulnerable" (p. 1069).

C. Wildlife responses may not necessarily represent population-level consequences; for more about this, refer to page 14.

Below is list of some recreation-related ecological impacts; the order of entries is immaterial. An effort has been made to provide excerpts and summaries that correctly reflect definitive results in the cited articles, though this list does not provide all the results of each cited article. It is always advisable to consult the source article to obtain the full context of the excerpted text so as to avoid misinterpretation or taking the excerpts out of context.

1. "One of the most significant characteristics of mountain biking as a form of wildlife disturbance is a result of the potential relative speed and silence of the activity. A relatively fast moving, quiet mountain biker may approach an animal without being detected until well within the normal 'flight response zone.' The result may be a severe startle response by the wildlife species with significant consequences to the animal and/or the mountain biker" (Quinn & Chernoff, 2010, p. 2). "The sudden encounter is the most common situation associated with grizzly bear inflicted injury" (Herrero, 1989, as cited in Quinn & Chernoff, 2010, p. 19). While there are methods for mountain bikers to give warning of their pending ride-by (e.g., bear bells attached to bikes - refer to Bike Bell Program at http://www.sdmba.com/bike_bell_program.php), and these can be effective for their purpose, they can also introduce additional disturbance to wildlife.

2. In a controlled study of the impacts from mountain biking on Golden-cheeked Warblers (GCWA)

18 Could there be a second explanation for the non-supplemented birds not flushing? A possibly anthropomorphic question is, Could it be that the non-supplemented birds are not necessarily more vulnerable to the particular human disturbance tested, but that they "choose" to conserve their energy (unless they really have to flush) and thus their threshold for responding is higher – they are more discerning about when to flush, whereas the supplemented birds can afford to "waste" energy?

with nests near the biking trails, observations suggest that disturbance from mountain biking does not affect GCWAs' daily activity budgets (e.g., foraging and nesting) (Davis, Leslie Jr., Walter, & Graber, 2010). But, direct observations of GCWA encounters with [passing] mountain bikers did show that they disturbed the birds. Furthermore, in comparison to the control sites, it is likely that habitat fragmentation and alteration by trails in the biking sites increased vulnerability of GCWA nests in those areas to predation by rat snakes and other edge-adapted predators. The direct impacts of mountain biking on GCWA may be minimal, but the indirect impacts from fragmentation and alteration of habitats from mountain bike trails may reduce the quality of nesting habitat for GCWA. "Several studies have suggested that habitat fragmentation negatively impacts [GCWA] nest survival" (Fink 1996; Maas-Burleigh 1998; Peak 2007; & Reidy et al. 2008, 2009 as cited in Davis et al., 2010, p. 470), in particular with increased vulnerability to nest predation (Reidy et al. as cited in Davis et al., 2010) and lower prey abundance (Jokimaki et al., Kilgo as cited in Davis et al., 2010). The authors speculate that the biking sites, which were currently able to maintain viable populations of GCWA, may not continue to do so with additional use, fragmentation, and alteration of the habitats [which] could impact productivity by affecting densities of breeding adults, pairing success, or predator abundance (Reidy et al. as cited in Davis et al, 2010).[19]

3. Weiss et al. (2016) assessed the role of mountain bikes as potential dispersal vectors in areas of conservation concern near Freiburg, Germany, and found the following. "Most seeds detached from the mountain bike within the first 5-20 m. However, a small proportion of seeds remained on tires after 200-500 m. Attachment was higher, and the rate of detachment slower, in semi-wet conditions and lighter seeds travelled farther. Seed dispersal by mountain bikes was moderate compared to other forms of human mediated dispersal. However, we found that lighter seeds could attach to other bike parts and remain there until cleaning which, depending on riders' preferences, might only be after 70 km and in different habitats… We demonstrate that mountain bikes are effective seeds dispersers at landscape scales" (p. 326)[20]

4. In a study using data collected in 112 urban parks throughout Melbourne, Australia, Bernard et al. (2018) tested whether bicycles and walkers cause different responses from wildlife, and concluded that:
   a. "overall, birds tended to have longer [flight initiation distances (FID)] in response to bicycles than walkers, but did not distinguish between fast and slow bicycles" (p. 278).
   b. "for some [of the 57] species of birds [observed], bicycles evoke responses at longer distances and/or higher intensity responses [than walkers]. For no species were bicycles associated with reduced responses compared with walkers" (p. 278).
   c. "When all 57 species were pooled, bicycles did not evoke longer FIDs than walkers. Single species models revealed that bicycles evoked longer FIDs for four of 12 well-sampled species. The response towards bicycles was more intense (i.e., more likely to involve flying) than to walkers for two of ten species" (p. 276).

---

19 There is much peer-reviewed literature on the ecological impacts of fragmentation, defined by Cheptou, Hargreaves, Bonte, and Jacquemyn (2017) as the process by which habitats are transformed into smaller patches isolated from each other. "[Fragmentation] has been identified as a major threat for biodiversity" (Cheptou et al., p. 1). This Primer does not address fragmentation in depth because the articles reviewed do not. However, fragmentation exacerbated by unauthorized trails and poorly planned designated trail systems poses serious implications for the long-term viability of the conservation lands in San Diego County.

20 It is not apparent from the article whether, for the rides that went to at least 500 meters, the authors measured how far beyond 500 meters all the seeds had detached, and if so, what the average additional distance was. This is important because distance travelled is the one variable that distinctly sets mountain biking apart from most other outdoor non-consumptive non-motorized recreational activities – refer to page 16. And, as to transport of seeds on clothing, a question is, do seeds attach to and detach from clothing at the same rate as for bikes.

5. In an analysis of camera-trap data collected in the Nature Reserve of Orange County (NROC), California, George and Crooks (2006) found the following regarding the responses of bobcat, coyote, and mule deer to bikers, hikers, horseback riders, dogs walkers, and motorized vehicles.
   a. "Bobcats were not only detected less frequently along trails with higher human activity, but also appeared to shift their daily activity patterns to become more nocturnal in high human use areas; negative associations between bobcat and human activity were particularly evident for bikers, hikers, and domestic dogs. In general, 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. Although we did not find a clear and consistent pattern of avoidance of human recreation by deer, the probability of detecting deer during the day was lower with increasing levels of human recreation" (p. 107).
   b. "Negative associations between bobcat activity and specific recreational categories suggested spatial displacement in response to bikers and hikers and temporal displacement in response to bikers, hikers, and dogs, but no displacement in response to equestrians or motorized vehicles. Although to a lesser degree than bobcats, coyotes also appeared to exhibit spatial displacement in that coyote activity was lower in the sites with the most recreation and was negatively related to overall human, hiker, and biker visitations; a trend of temporal displacement in response to dogs also was evident" (p. 111).

6. "A total of 59,483 wildlife and human activity records were analyzed across 49 cameras positioned throughout the Orange County NCCP Central and Coastal Reserve and adjacent IRC-managed Easement Lands, spanning from June 2007 – December 2011. In all, 17 mammals and 34 bird species were recorded" (Burger 2012, p. 41).
   a. Though the analyses of the camera-trap data do not suggest a change in wildlife activity at a large scale, "short-term (single-day) patterns in wildlife activity appear to be strongly affected by presence of humans at a given site. Wildlife was on average nearly four times as likely to be recorded on days with no human activity as on days that human disturbance was recorded by a camera trap. Wildlife activity decreased incrementally with increasing number of human observations within a day…, but fell to near zero probability at human incidences somewhere over 60 in a single day" (Burger 2012, p. 48).
   b. Pedestrians (hikers and runners) had the greatest negative correlation with local wildlife activity, whereas equestrians had the lowest. However, all common user groups were negatively correlated, so, again, the differences between user groups are less important than the negative association of human presence, irrespective of type. (Burger 2012, p. 49).

7. "Avoidance [by mammals of human activity] was evident regardless of species, regardless of the type of human activity, and regardless of camera placement. The overall trend is sharply negative: as human activity increases, mammal activity decreases" (Patten et al. 2017, p. 35).

8. By applying a novel statistical analysis to compiled camera data from fifty fixed locations within a complex of urban and urban-adjacent publicly-owned conserved lands in Orange County across four and a half years, Patten and Burger (2018) assessed the general pattern of wildlife detections in the broadest sense and wildlife response to human disturbance.[21] The authors found that:
   a. same-day co-occurrence of wildlife and humans was significantly lower than expected at > 90% of the cameras;
   b. human presence acutely affects same-day wildlife detections in protected areas; and

21 For this Primer, there was no assessment of the legitimacy of the statistical analyses, including the modelling, used in the studies. In truth, any such assessment is beyond the author's comprehension of most of the analyses used. The results of the statistical analyses are assumed to be valid.

c. among hikers, bikers, domestic dogs, vehicles, and equestrians, hikers and runners had the greatest negative correlation with local wildlife detections, whereas equestrians had the lowest, yet all common recreational activities were correlated negatively with mammal detection.

9. The authors combined noninvasive survey techniques [using scat] and DNA verification of species identifications to survey for mammalian carnivores in 28 parks and preserves in northern California (Reed & Merenlender, 2008).
   a. "Paired comparisons of neighboring protected areas with and without recreation revealed that the presence of dispersed, nonmotorized recreation led to a five-fold decline in the density of native carnivores and a substantial shift in community composition from native to nonnative species" (Reed & Merenlender, 2008, p. 1).
   b. "The presence of quiet, nonconsumptive recreation[22] correlated with a substantial shift in the composition of the carnivore community in California protected areas. A greater mean number of native species was detected in protected areas that did not permit recreation…($P = 0.0011$) and bobcats in particular were detected more frequently in protected areas without recreation ($P = 0.013$). On the other hand, more nonnative species were detected in protected areas that permitted recreation…($P < 0.001$), and domestic dogs were detected more frequently in the recreation areas ($P < 0.001$)" (Reed & Merenlender, 2008, p. 7).
   c. "Densities of coyotes and bobcats were more than five times lower in protected areas that permitted recreation" (Reed & Merenlender, 2008, p. 8).[23]

10. In a study subjecting 13 female elk (*Cervus elaphus*) to 4 types of recreational disturbance (all-terrain vehicle (ATV) riding, mountain biking, hiking, and horseback riding) in northeast Oregon from April to October in 2003 and 2004, the authors recorded the elks' resting, feeding, and travel activities in response to the disturbances (Naylor, Wisdom, & Anthony, 2009).
   a. "Elk fed and rested during control periods, with little time spent traveling. Travel time increased in response to all 4 disturbances and was highest in mornings. Elk travel time was highest during ATV exposure, followed by exposure to mountain biking, hiking, and horseback riding. Feeding time decreased during ATV exposure and resting decreased when we subjected elk to mountain biking and hiking disturbance in 2003" (Naylor et al., 2009, p. 328).
   b. "The reduced response by elk to each treatment in afternoons compared to mornings was likely due to elk moving away from the disturbance and avoiding them for the remainder of the day" (Naylor et al., 2009, p. 333).
   c. "In contrast to horseback riding, elk travel time during mountain bike riding was above that of controls for each year and was consistent among years. Thus, elk showed no evidence of habituation to mountain biking. Similarly, elk travel time in response to hiking was above that of control periods, with the exception of replicate 1 for 2003, suggesting a similar response by elk to each hiking disturbance (i.e., no habituation)" (Naylor et al., 2009, p. 334).
   d. "….ATV riding and mountain biking… caused the largest reductions in feeding time and increases in travel time" (Naylor et al., 2009, p. 335).

11. "A study of the Boise River in Idaho examined flushing distances of bald eagles when exposed to actual and simulated walkers, joggers, fishermen, bicyclists, and vehicles (Spahr 1990). The highest frequency of eagle flushing was associated with walkers (46 percent), followed by fishermen (34

22 The authors define quiet, nonconsumptive recreation as dispersed, nonmotorized activities such as hiking, biking, and horseback riding.

23 About this study, Reilly, Tobler, Sonderegger, and Beier (2017, p. 118) state, "[The] use of carnivore scats as a proxy for carnivore population size is problematic because domestic dogs accompanying human recreationists can consume and disturb scat of bobcats and coyotes, decreasing detection probabilities and likely lead to underestimation of carnivore populations."

percent), bicyclists (15 percent), joggers (13 percent), and vehicles (6 percent). However, bicyclists caused eagles to flush at the greatest distances (mean = 148 meters), followed by vehicles (107m), walkers (87m), fishermen (64m), and joggers (50m). Eagles were most likely to flush when recreationists approached slowly or stopped to observe them, and were less alarmed when bicyclists or vehicles passed quickly at constant speeds. Similar findings have been reported by other authors, who attribute the difference in flushing frequency between walkers and bikers/vehicles either to the shorter time of disturbance and/or the additional time an eagle has to "decide" to fly (Van der Zande and others. 1984)" (Marion & Wimpey, 2007, p. 13).

12. In a review of recreation ecology research, Pickering, Hill, Newsome, Leung (2010) found the following. Note that Pickering et al.'s (2010) attention was to soil and vegetation, not wildlife.
    a. "Mountain bike specific impacts include soil and vegetation damage from skidding and the construction of unauthorised [*sic*] trails, jumps, bridges and other trail technical features" (Pickering et al., 2010, p. 551).
    b. With respect to hiking, "Based on the published research seed from 179 species of plants have been collected from clothing and equipment of which 43 are considered serious environmental weeds internationally" (Mount and Pickering as cited in Pickering et al., 2010, p. 553).
    c. "Recent work by Davies and Newsome (2009) and Newsome and Davies (in press) in Western Australia, in contrast [to previous studies whose focus was erosion and degrading tail conditions], found a range of specific social and biophysical impacts arising from mountain biking. These include trail impacts such as erosion from skidding, linear rut development, user conflict and the addition of unauthorized constructed features to existing trail networks. In addition, a number of off trail impacts were identified including the creation of informal trails, creation of constructed features (technical trail features) along with reduced amenity" Pickering et al., 2010, p, 555).[24]
    d. "[Goeft and Alder (2001)] concluded that even though bike riders prefer downhill runs, steep slopes, curves and water stations (features related to higher impacts), mountain biking is sustainable so long as that [sic] trails are appropriately designed, located, and managed (Newsome and Davis, in press)" (Pickering et al., 2010, p. 555, emphasis added).

13. In Reed et al. (2014, p. 95). Literature Review Paper: Pineiro, A., I. Barja, G. Silvan, and J. Carlos Illera. 2012. Effects of tourist pressure and reproduction on physiological stress response in wildcats: management implications for species conservation. *Wildlife Research* 39:532–539. The four-year study in north-western Spain was conducted in a reserve divided into three zones according to the level of tourism allowed: restricted public-use, restricted zone, and integral reserve. An enzyme immunoassay technique was used to quantify cortisol metabolites and sex hormones from each of 110 fresh wildcat fecal samples collected from walked transects on forest roads within each zone. The number of visitors (i.e., human disturbances) was recorded as a measure of tourist pressure. The key results were: (a) park zone and fecal progesterone levels were the factors that explained the variation in the fecal glucocorticoid metabolite levels, (b) cortisol metabolite concentrations were higher in some park zones where tourism intensity was higher, and (c) fecal cortisol metabolite concentrations were more elevated during gestation (spring) and during the young dispersal period (autumn). The authors, therefore, recommend that some zones of the park (integral reserve) continue being maintained free of visitor impact and that visitor numbers be specially controlled during the animals' sensitive periods (gestation) in the zone of restricted public use and in the

24 The author does not have the article by Newsome and Davies that was in press in the *Journal of Ecotourism*. But, based on its title - *A case study in estimating the area of informal trail development and associated impacts caused by mountain bike activity in John Forrest National Park, Western Australia* – and the fact that Pickering et al. submitted their article to *Journal of Environmental Management* in July 2009, it's likely that Newsome and Davies' published article is similar to the Davies and Newsome 2009 article cited elsewhere here – refer to the listed references.

restricted zone.

14. There are few examples in the reviewed articles of conclusive evidence of recreation-related ecological impacts at the landscape- or population-level, but this does not mean that such impacts are rare – refer to discussion starting on page 14. Here are four examples of conclusive or close-to-conclusive evidence.
    a. "We demonstrate that mountain bikes are effective seeds dispersers at landscape scales" (Weiss et al., 2016, p. 326).
    b. Patten & Burger (2017) found no evidence suggesting mammalian populations have declined reserve-wide between mid-2007 and mid-2016 despite the marked increase of human activity during the same period. But, they did discern temporal and spatial shifts by wildlife due to human presence and suggest 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 avoidance of humans in protected areas" (p. 36). The authors also state, "given avoidance behavior and temporal shifts of the various mammal species, any further increase in human disturbance may yet drive mammal populations downward" (p. 36).
    c. Burger (2012) states, "[b]irds may respond to human presence by flushing (flight) (Blumstein *et al.*, 2005; Blumstein *et al.*, 2003), shifting home ranges (Anderson *et al.*, 1990; Wasser *et al.*, 1997), or otherwise disrupting their routine behavior (Steidl & Anthony 2000). These behaviors will likely have a negative impact on the population if the energy loss associated with their performance leads to a decrease in breeding success (Gill 2007, Gill *et al.*, 2001)" (p. 12).
    d. A review Steven, Pickering, and Castley (2011) conducted to assess the current (1978 – 2010) peer-reviewed recreation ecology literature in English about original research on the effect of non-motorized nature-based recreation on birds produced 69 articles, 50 of which were about research conducted in protected areas. The activities covered were standing/observing wildlife, walking/hiking, running, mountain biking, canoeing, dog walking, and horseback riding. The response of birds was assigned as either an individual response (physiological or behavioural) or population-level response, the latter entailing both density/abundance and reproductive response (number of nests, number eggs laid, number of chicks that hatched or fledged). Of the 33 articles that examined population-level (reproductive success) responses of birds, 85% reported negative effects, with five reporting no effect on birds. Notably, only three of the 69 articles considered mountain biking.

15. "Some behavioral or physiological changes [in wildlife in response to human disturbance] can have acute effects on individuals' vital rates [survival, reproductive success, and growth rate, the latter affecting age at first breeding], for example, by changing their predation risk or because injury directly affects their survival probability (Hooker et al., 2012). [S]uch changes can also affect vital rates indirectly by impairing an individual's health." (Pirotta et al., 2018, p. 9938).

16. Reed and Merenlender (2008) provide an important assessment: "For moderately sized protected areas (50–2000 ha) near urban development, the key variable seems to be whether or not the site is open to public access" (Reed & Merenlender, 2008, p. 151). [50 hectares = 123.553 acres & 2000 hectares = 4942.108 acres]

17. Refer to page 11 for information about unauthorized trails.

It is fitting to discuss here the one article reviewed that might be considered an outlier relative to those cited in the list above. Reilly, Tobler, Sonderegger, and Beier (2017) used camera trap data (9099 independent images) collected from May – August in 2012-2013 to quantify how non-motorized recreation (hiking, cycling, horse-riding, and dog-walking) affects occupancy and shifts in activity patterns of ten mammalian species (mule deer, mountain lions, coyote, bobcat, raccoon, grey fox, opossum, striped skunk, rabbit, feral pigs) in eight counties of the San Francisco Bay Area. The minimum parcel size of the 87 parcels with cameras was approximately 14 acres and the majority of the 241 sites (within the 87 parcels) were sampled once. Some of the salient observations from this study follow.

a. DIEL shifts:
   - coyotes (significantly) and mule deer (not significantly) in areas of high recreation shifted their activity away from daylight hours and toward crepuscular or nighttime hours in high recreation areas compared to areas with no recreation;
   - striped skunk in areas that allowed recreation was slightly more active in the morning than striped skunk in areas without recreation;
   - none of the other species showed a significant change in activity patterns;
b. two significant associations between recreation and wildlife habitat use: presence of domestic dogs was negatively associated with mountain lions and Virginia opossums;
c. OCCUPANCY: no negative association between recreation and habitat use by bobcats and coyotes, the two species for which Reed and Merenlender (2008, 2011) documented strong negative responses in the same study area (refer to footnote 23);
d. ACTIVITY PATTERNS: coyotes shifted their activity away from daylight hours and toward crepuscular or nighttime hours in high recreation areas.

Reilly et al. (2017) state, "Previous research in urban nature reserves, reported lower probabilities of detection for deer in areas with higher levels of recreation during the day but also found no spatial avoidance of deer to recreation (George and Crooks, 2006). We found that mule deer continue to exist even in areas with high levels of recreation by making slight shifts to their diel activity patterns" (p. 124).

In contrasting their results with those of George and Crooks (2006), Reilly et al. (2017) do not acknowledge much less consider Gill et al. (2001) who maintain that proximity to other suitable habitat influences how wildlife will respond to human disturbance.[25] This is perplexing since George and Crooks (2006) not only acknowledge but give credence to Gill et al.'s work in their article.

It is not apparent if there were notable differences among the factors in Reilly et al.'s and the other authors' studies that might explain the contrasting results, factors such as size of habitats, disturbance levels, and most notably (in deference to Gill et al.) proximity to other suitable habitat. One factor that may have differed markedly between Reilly et al.'s and George and Crooks' studies is the minimum parcel size where cameras were located - in Reilly et al.'s study, it was approximately 14 acres, which is presumably considerably smaller than in George and Crooks' study. Further insight to this quandary would be appreciated.

25 "The response of animals to predation risk is exactly the same as the response to [human] disturbance; a species with suitable habitat nearby may avoid disturbance simply because it has alternative sites to go to. By contrast, animals with no suitable habitat nearby will be forced to remain despite the disturbance, regardless of whether or not this will affect survival or reproductive success. This will also mean that avoidance behaviour may vary both temporally and between locations, depending on the prevailing local conditions… Species with little suitable habitat available elsewhere cannot show marked avoidance of disturbance even if the fitness costs are high, whereas species with many alternative sites to move to are likely to avoid disturbance even if the fitness costs are low. Traditionally, species showing strong negative relationships would be considered to be those most in need of protection from disturbance. However, … this response could in fact be the result of differences in the availability of habitat elsewhere. Thus, species may be able to avoid disturbance because they have alternative sites to go to. By contrast, species may not avoid disturbance because they have no other sites to occupy" (Gill et al., 2001, p. 266).

A BIT ABOUT HABITUATION

"Unlike attraction, which involves a reinforcing stimul[us], habituation is a waning of response to a repeated, neutral stimul[us]" (Whittaker, 1998, p. 313). "Habituation… allows animals to dedicate energy toward fitness-enhancing behaviors such as foraging and mating instead of expending energy to flee activities that result in neutral outcomes" (Reilly et al. 2017, pp. 125).

An example helps to distinguish habituation from attraction: a bear in the habit of going to a garbage dump to look for food is exhibiting attraction, not habituation; if the bear were habituated to human food, he would ignore it (Whittaker, 1998). "Habituation is also an apt description for crows (*Corvus* spp.) ignoring a scarecrow, or a red fox (*Vulpes vulpes*) ignoring the human activity of a suburban area" (Whittaker, 1998, p. 313).

"[D]esensitization of large mammals to human recreation may result from habituation… The ability to habituate to predictable and recurrent human use of recreational trails may be an important behavioral adaptation for wildlife in urban areas, allowing them to continue normal behaviors, such as resting, foraging or breeding, when confronted with continued human activity. However, habituated urban wildlife might be less likely to avoid contact with humans, and thus may be more likely to be attracted to anthropogenic food sources such as lawns or gardens for ungulates or pets, trash, and cultivated fruits for carnivores. Habituation may also increase wildlife aggression towards humans, or render wildlife more vulnerable to hunters, poaching, or road-kill. Because habituation can increase the probability of human-wildlife conflicts, it is considered an emerging problem in many urban areas" (George and Crooks 2006, p. 115, with Whittaker 1998 heavily cited).

"[H]abituation of adult individuals may be associated with negative consequences for their offspring as habituation of adult animals does not translate to immediate habituation of juveniles. Wildlife habituated to human presence and occurring near developed area may increase the probability of… human wildlife interactions and conflicts. Bobcats and coyotes in urban corridors have a greater risk of mortality caused by vehicular collisions" (Reilly et al. 2017, pp. 124 & 125).

"While resource scarcity and lack of alternative sites to move to may explain some of [what appears to be] 'habituation,' (Gill et al., 2001) the ubiquity of the effect across studies suggests that ungulates do habituate to humans in heavily populated areas… However, habituation to even low impact, nonconsumptive, human stressors (e.g., hiking and mountain biking) may take many years or never occur at all" (Stankowich 2008, p. 2168).

For information about habituation vs adaptation, refer to:
https://www.researchgate.net/publication/316029169_Habituation_and_adaptation_to_odors_in_humans
https://study.com/academy/lesson/sensory-adaptation-habituation-definition-examples.html

For ease of reading, this discussion omits most of the numerous citations to the primary sources that each of the cited articles uses. Please refer to the cited articles for citations and references to those primary sources.

Unauthorized Trails on Conserved Lands

Importantly, both the NCCP/HCP (1996) and the IA (1996) for the OC NCCP/HCP Program explicitly restrict mountain biking to **designated trails** (pages II-294 and 59, respectively), a restriction that is consistent among other NCCPs/HCPs and lands conserved for biological resources. Recreation is allowed as a compatible use in part because it is expected to be managed to be consistent with the **primary** species and habitat protection mission of the permanent reserve by avoiding significant degradation of biologic resources within the reserve (OC NCCP/HCP, 1996, pp. II-346 – 347).

However, in San Diego County, disregard for and lack of enforcement of this restriction is readily apparent on many conserved lands in the form of unauthorized trails and technical trail features (e.g., TTF - jumps, bridges, ramps, ladders, drop offs, 'skinnies' - narrow items that can be traversed, and see saws; Davies & Newsome, 2009 use the term "technical trail features"). The literature refers to illegally created trails and TTFs variously as unauthorized, informal, social, unofficial, off-trail, visitor-created, or user-created. "Unauthorized" is the term of choice here because it is the only term among these that clearly denotes the illegality of such trails and features.[26] Unauthorized trails are not planned, approved for construction, nor managed (Davies & Newsome, 2009). Mountain bikers create these trails by repeated wear along users' desired pathways (SANDAG, 2015).

"Informal trails are increasingly generated by mountain bicyclists, in particular, who seek more challenging, wider-ranging, or "free riding" opportunities (e.g. Hardiman & Burgin, 2013; Newsome & Davies, 2009)" (Havlick, Billmeyer, Huber, Vogt, & Rodman, 2016, p. 2). Informal trails may also develop because riders want a "short cut to reach specific destinations or to connect existing tracks (Marion 2007, pers. comm., 30th August, IMBA 2007)" (Davies & Newsome, 2009, p. 6). "If a trail is not sited in a place where riders want to go then informal trails will be formed by off-roading" (Goeft & Alder as cited in Davies & Newsome, 2009, p. 13), as reflected in Berg's (2014, p. 4) statement, "As an avid mountain biker, I am always looking for new trails to ride because many of the existing trails are very limited in both length and difficulty. Many other bikers experience the same frustrations and sometimes go so far as to build their own trails."

"The establishment of [unauthorized trails] is now commonplace and is leading to concerns about the sustainability of these activities in many public recreation areas around the world (e.g. Ballantyne, Gudes, & Pickering, 2014; Barros, Gonnet, & Pickering, 2013; Barros & Pickering, 2015; Marion, Wimpey, & Park, 2011; Newsome & Davies, 2009; Philipps, 2011; Pickering, Castley, Hill, & Newsome, 2009)" (Havlick et al., 2016, p. 2).

Despite the proliferation of unauthorized trails and TTFs, of the 36 recreation-related articles reviewed for this Primer, only two have a term denoting "unauthorized" in reference to trails in their title; these are (1) Havlick et al.'s (2016) article with "informal" in the title, though not specific to mountain biking, and (2) Keltz's (2018) SDUT article with "illegal" in the title. Only Havlick et al. (2016) and Davies and Newsome (2009) consider the ecological impacts from unauthorized trails in any depth.[27] Only nine (9) other articles mention or address unauthorized trails (by that or another term) in some manner. A comprehensive literature search by Pickering et al. (2010) in all major recreation ecology references, a series of electronic databases, and the authors' own reference libraries, produced (a) only two studies documenting the impacts of informal trails, and (b) only two studies documenting mountain bike specific damage. In both cases, both studies were conducted ißn Australia. At that time, impacts from mountain biking had rarely been assessed, including the creation and use of unauthorized trails and TTFs. Davies and Newsome (2009) contended that, though past research had (at that time) indicated that the relative impacts of bikers and hikers in natural areas are similar, such research used controlled passes of hikers and bikers on established trails along with general trail assessment methods to determine mountain biking impacts. This seems to remain the case.

The paucity of information available on the ecological impacts from the creation and use of unauthorized trails and TTFs represents a serious and puzzling gap in the research.

26 In a fairly recent change to their website, the County of San Diego Department of Parks and Recreation uses "unauthorized" to refer to trails at http://www.sdparks.org/content/sdparks/en/news-events/news-stories/ParkNoticesandClosures.html in the entry for Sycamore Canyon / Goodan Ranch.

27 Of the articles reviewed, Pickering et al. (2010), SANDAG (2015), Weiss et al. (2016), and Patten et al. (2017) use the term 'unauthorized' in this context.

Some articles indicate that the impacts of unauthorized trails occur primarily during their creation (e.g., Havlick et al., 2016). While this is true with respect to the initial removal of the vegetation and the damage to the terrain, it reflects an apparent nonrecognition of the (a) fragmentation that such trails add to what are in many instances already fragmented landscapes, (b) diminution of the suitability to wildlife of the adjacent and surrounding habitat, (c) ongoing impacts on wildlife from human disturbance that occurs along the unauthorized trails, (d) propensity for riders to view unauthorized trails and TTFs as a license to create more, and (e) erosion and damage to downstream terrain and waterways , if any within the area of influence of the erosional forces and flows.

The following excerpts capture the salient points about unauthorized trails and TTFs from the reviewed articles.

1. "The creation of informal trails increases the amount of land, fauna and flora subject to impact by adding new trails or widening existing trails (Cessford 2003, Marion 2007, pers. comm., 30th August)" (Davies & Newsome, 2009, p. 6).

2. "[O]ff-trail travel… can quickly lead to the establishment of informal visitor-created trails that unnecessarily remove vegetation cover and spread non-native plants. Such routes often degrade rapidly and are abandoned in favor of adjacent new routes, which unnecessarily magnify the extent and severity of trampling damage." (Marion & Wimpey, 2007, p. 7).

3. In a study by Havlick et al. (2016) considering the initial impacts on vegetation cover caused by mountain bicycling, trail running, and hiking in a shortgrass prairie environment, "[v]egetation cover measurements were taken at multiple intervals following experimental recreational use on three uphill and three downhill trail segments. All three activities caused statistically significant increases in bare ground cover between the first baseline measurement and post-treatment sampling one year later. Short-term impacts were more variable: walking and bicycling caused statistically significant increases in bare ground, but running did not" (p. 1).
   a. "Informal trails are often created directly by trampling and surface scouring by users (some user-created trails are constructed to varying degrees, but many are simply formed by repetitive use), and the trail alignment commonly disregards management or biophysical considerations of sustainability, and instead prioritizes expediency or recreational appeal" (p. 2).
   b. "Even relatively few off-trail excursions by a party of recreationists can generate impacts that lead to informal trail formation (Barros & Pickering, 2015)" (p. 14). This means that it can take only a "few" passes into previously undisturbed vegetation to create enough of a "visual" cue to "invite" others to take that route (p. 14).
   c. "After extended use (i.e. 500 passes), the damage to vegetation cover from bicycling appears to be more extensive than that caused by either hiking or trail running, a finding supported by Pickering et al. (2011), who found that in Australian subalpine grasslands, bicycles caused more damage than hikers after 500 passes" (p. 15).

4. "In comparison to pedestrians, mountain bikers move quickly and quietly, and in the [Nature Reserve of Orange County] also travel off designated trails, and thus may be especially unpredictable and hence disruptive to wildlife (MacArthur et al., 1982; Knight and Gutzwiller, 1995; Miller et al., 2001; Taylor and Knight, 2003)" (George & Crooks, 2006, p. 112).

5. "Informal trails created by off-trail travel frequently have steep grades and fall-line alignments that quickly erode, particularly in the absence of tread maintenance. Exceptions include areas of solid rock or non-vegetated cobble" (Marion & Wimpey, 2007, p. 4.)

6. “Free riding has often involved off-trail riding. This tends to have high environmental impacts except on extremely tough surfaces like bare rock or un-vegetated stony ground (CALM 2007)” (Davies & Newsome, 2009, p. 3).

7. “Illegal trampling, and collecting, can deplete floral and faunal populations, reduce biodiversity, and alter trophic and community structures in frequently visited natural habitats” (California Department of Fish and Wildlife, 2015, Volume 1 p. 2-4).

Impacts Not or Very Insufficiently Studied or Considered

In addition to the gap in information about the ecological impacts of the creation and use of unauthorized trails and TTFs, there are several other types of impacts (or factors influencing them) that are not at all or are very insufficiently considered, studied, researched, or accounted for in the available literature. This discussion identifies some of these impacts and factors, while acknowledging the complexity of designing and conducting studies that provide valid conclusions about recreation-related ecological impacts.

Population- , Community-, and Landscape-level Impacts

Assessing and managing the nonlethal impacts of disturbance on wildlife populations has long been a goal of ecologists, decision makers, and managers (Pirotta et al., 2018). “The management of human activities that have nonlethal effects on wildlife is a specific example of 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, p. 9934).

In an article discussing whether avoidance of disturbance is likely to be a good measure of population-level impacts, Gill, Norris, and Sutherland (2001) explain the following.

a. From a strictly “conservation perspective, human disturbance of wildlife is important only if it affects survival or fecundity and hence causes a population to decline. It is therefore vital for conservationists to know whether avoidance of disturbance does in fact result in population change (Sutherland, 1996; Sutherland, 1998; Gill and Sutherland, 2000)” (p. 266).
b. “[T]he actual fitness costs of… changes in behaviour need to be quantified before they can be used as reliable estimates of the impact of disturbance on populations” (p. 267).
c. “[I]n order to assess the impact of disturbance on population size and the relative susceptibility of different species, future studies need to address how behavioural changes in response to disturbance affect demographic parameters such as survival and reproductive success” (p. 267).
d. “From a population viewpoint, the species most likely to be adversely affected by disturbance are those for which the fitness costs are high but they have little excess habitat to move to… and are thus constrained to stay in disturbed areas and to suffer the costs in terms of reduced survival or reproductive success” (p. 266). This underscores the gravity of the consequences of fragmentation, hence Priority 3b.

“Short term effects may not reflect longer term population level responses to disturbance (Gill et al., 2001; Steidl and Powell, 2006)” (Steven at al., 2011). Previous reviews of mammals’ behavioral responses to human recreation have “emphasized that the population-level and demographic effects of human disturbance on wildlife are still poorly known” (Burger, 2012, p. 10). “Although prior studies provide valuable data on the behavioral responses of individual wildlife species to specific recreational

activities, they rarely address the landscape- or community-level effects of recreation" (Reed et al., 2014, p. 4).

Comprehensive assessments of the nonlethal impacts on wildlife at the population level are rarely undertaken, due to several constraints, including that robust assessment of these impacts is challenging (Pirotta et al., 2018). "As a result, management decisions have been generally based on evidence of behavioral responses to disturbance, although such responses may have no population-level effect (Christiansen & Lusseau, 2015). Conversely, the absence of an obvious behavioral response does not rule out a population-level effect (Gill, Norris, & Sutherland, 2001). Given the increasing expansion of activities that can disturb wildlife, quantitatively linking disturbance to population dynamics is a major objective for modern conservation (Gill et al., 2001)" (Pirotta et al., 2018, p. 9935). Based on a systematic review of 274 articles in the scientific literature through the year 2015, Larson et al. (2016) conclude that "[b]ehavioral metrics, which were studied far more often than other types of responses, may be popular because they can be simpler to measure and have been proposed as a proxy for demographic parameters [90]. Nonetheless, behavioral metrics may not reflect the true population consequences of anthropogenic disturbance [91]" (p. 16).[28]

Reed et al. (2014) propose to develop and apply a "landscape level model to assess the potential impact to wildlife from recreation activity, by overlaying estimated recreation use at NCCP reserves with known locations of sensitive wildlife species" (pp. 25 & 155). Pirotta et al.'s article explores a range of statistical models that either have been or could be used "to estimate the population-level effects of disturbance[;] [i]n most situations, selection of a model structure to forecast the population-level effects of disturbance is likely to be driven by data availability" (Pirotta et al., 2018, p. 9939). "Whichever model is chosen, it is necessary to quantify uncertainty at all stages of modeling (Harwood & Stokes, 2003; Milner-Gulland & Shea, 2017)… Uncertainty in the estimated population consequence ultimately can be reported as a distribution of potential outcomes. This will allow the precautionary principle to be applied if the results are used to make management decisions" (Pirotta et al., 2018, p. 9941).

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

Until such time, if ever, there is sufficient empirical data with which to assess the cumulative population- and landscape-level impacts of all anthropogenic disturbance, including recreational activities, "the most sensible approach may… be to concentrate research and protection efforts on species that are threatened or whose populations are declining, and for which human disturbance is implicated as a possible cause" (Gill et al., 2001, p. 267). The NCCP/HCP programs embody this very approach, but when the lands conserved pursuant to these programs are not adequately managed and protected, their ecological viability and ability to meet the programs' conservation objectives are jeopardized.

Cumulative & Synergistic Impacts

"There is a tremendous need for research that addresses the cumulative effects of human recreational activity in protected areas. This includes the need to identify thresholds associated with numbers, timing

28 Citation 90 is to Wildermuth RP, Anadon, J.D., Gerber, L.R. Monitoring behavior: assessing population status with rapid behavioral assessment. *Conserv Lett*. 2013; 6: 86–97 and citation 91 is to Gill, J.A., Norris, K., Sutherland, W.J. The Effects of Disturbance on Habitat Use by Black-Tailed Godwits Limosa limosa. *J Appl Ecol*. 2001; 38: 846–856.

and distribution of use" (Quinn & Chernoff 2010, p. 23). "Ultimately, effects of disturbance must be addressed with an understanding of the cumulative and synergistic nature of their occurrence" (Quinn & Chernoff 2010, p. 12) in conjunction with all other impacts on the biotic and abiotic features of the environment.

With respect to statistical modelling, Pirotta et al. (2018) state, "[m]ost [population consequences of disturbance, PCoD] models to date considered one disturbance source or scenario in isolation. However, multiple sources of disturbance are likely to occur in an area at any given time, together with other, concurrent environmental and ecological processes. Attributing causation to a single stressor and developing mitigation measures therefore is challenging in practice. Accordingly, the PCoD framework recently was expanded to incorporate the cumulative effects of multiple stressors and ecological drivers (National Academies, 2017)" (p. 9941).

Given the challenges involved in trying to assess the impacts on wildlife from a single type of anthropogenic disturbance, it may be infeasible to adequately assess cumulative impacts, which underscores the need to apply the precautionary principle.

Distance

Because mountain bikers travel faster than hikers (Taylor & Knight, 2003), they are capable of travelling farther per unit time than hikers (Taylor & Knight, 2003), and therefore "may have a higher spatial capacity for impact, increasing their relative impact when compared to hikers" (Davies & Newsome, 2009, p. 6).

"Most studies (82%) on avian [flight initiation distance] have focused on walkers (McLeod et al., 2013), even though bicycles are a prevalent feature of parks (Weston, Antos, & Glover, 2009), can cover longer distances and thus may have more extensive impacts." (Bernard et al., 2018, p. 277).

Even Lathrop (2003), an apparent biking advocate, states, "[B]ecause bicyclists are capable of and, in most areas, typically do travel much farther than hikers; it is reasonable to conclude that they will create a somewhat higher total number of encounters and flushings" (p. 9).

For valid comparisons among recreational activities of their ecological impacts, the comparisons must account for distance travelled and that, accordingly, bikers elicit responses from more individual animals; though, as already indicated, the differences among recreational user groups in their impacts on wildlife are less important than the negative association for wildlife of human presence, irrespective of type (Burger 2012; Patten & Burger, 2018).

Indirect Impacts (including edge effects)

"Most recreation ecology research has examined the direct impacts of different types of activities, with far fewer studies documenting the severity of indirect impacts (Newsome et al. 2002; Liddle 1997; Buckley 2003). However, compared with direct impacts, indirect impacts can be even more severe, can occur over a wider area, and may be more likely to be self-sustaining (i.e., they may continue to cause damage even if the activity itself stops) (Liddle 1997: Buckley 2003). One of the most important indirect impacts is the spread of weeds (Newsome et al. 2002: Liddle 1007)" (Pickering, 2010, p. 74).

Fragmentation of conserved lands resulting from trails can cause many indirect impacts. "Because tracks are linear disturbances, they can actually have a greater impact on a site than what would occur

from the same area in a more compact form. Roads and trails can fragment habitats" (Pickering 2010, p. 4).

Referring back to the account starting on page 4 of the study of Golden-cheeked Warblers (GCWA), the direct impacts of mountain biking on GCWA may be minimal, but the indirect impacts from fragmentation and alteration of habitats from mountain bike trails may reduce the quality of nesting habitat for GCWA.

"Mice and woodrats associated with coastal sage scrub in the Santa Monica Mountains decreased in species richness and abundance in areas with trails and other human-related vegetation disturbances" (Sauvajot et al. as cited in Burger, 2012).

Duration and Degree of Wildlife Response

Research that concludes that there is a negative correlation between human activity and wildlife activity seldom provides insight to the duration of the wildlife response (e.g., nest abandonment, interruption of foraging / hunting, breeding, fleeing) or degree of response (e.g., how far wildlife moves away from human disturbance at a greater energetic cost and resulting in less habitat being available to them) (Burger 2012).

Little is known about the "duration of the effect of human activity and the spatial scale at which wildlife response is occurring… Further research should attempt to address the duration of the effect of human activity and the spatial scale at which wildlife response is occurring" (Burger 2012, p. 49).

Night Riding

Riding after dark, which is on the increase on conserved lands in San Diego County, can startle nocturnal wildlife or wildlife that has become increasingly nocturnal to avoid daytime recreationists' activities. Numerous studies have found urban wildlife, such as coyote, exhibit diel shifts and often have higher rates of nocturnal activity in urban settings (Alegria, 2015, p. 14).

Such temporal shifts in activity can result in less time for foraging and breeding, and can increase encounters with competitors. "High levels of human activity in the Santa Cruz Mountains, CA, increased the temporal overlap between several species of native carnivores potentially increasing interspecific competition (Wang et al., 2015)" (Reilly et al., 2017, p. 123). Temporal shifts can also affect prey availability for carnivores and cause other metabolic stresses (Reilly et al., 2017, Alegria 2015).

The increase in recreational activity after dark compounds the pressure wildlife experience from daytime recreational activities. "Coyotes in protected areas show temporal avoidance to specific levels of human recreation and may benefit from protected areas that incorporate wide undisturbed corridors that allow them to retreat from human recreation. Corridors for coyotes should contain densely mixed vegetation and forest and shrub habitat for hiding cover (Krausman et al., 2008)" (Reilly et al. 2017, p. 125). This logic also applies to sensitive species.

What to Do about the Proliferation of Unauthorized Trails…

The dual role (i.e., primarily to protect ecological resources and secondarily to provide recreational opportunities) of many if not most conserved lands in urban areas is increasingly difficult to maintain in a manner that serves the primary role as needed for conservation. This is especially true when there is

chronically: (1) high and ever-growing recreational pressure; (2) rampant deliberate or unconscious disregard for the legal restrictions on recreational activities; (3) insufficient land stewardship by the landowners and/or managers; (4) insufficient political will to adequately protect the ecological resources; and (5) insufficient fiscal support to provide adequate staffing to sufficiently enforce the legal restrictions and manage the conserved lands. Until each of these factors, some of which are closely interrelated, is adequately addressed, the proliferation of unauthorized trails and of trail plans that add too many trails (from an ecological perspective) to existing or new trail systems will continue.

The following discussion addresses each of these factors (not in the order listed) with the exception of #1, about which the only thing to say is that the trajectory of recreational pressure on conserved lands weighs heavily on the ecological resources and on the humans concerned about them.

Recreation is an important issue for ecologists and conservation planners to consider, because access for recreation is a key component of plans to generate public support and revenue for land conservation (Reed & Merenlender 2008). Public access is an important platform for generating tax and bond revenue for protected area acquisition (Reed & Merenlender 2008). Yet, agencies responsible for managing the conserved lands are chronically underfunded for this work.

Public Agencies' Lack of Sufficient Resources – An Excuse or Hard Reality?

Several of the articles reviewed point to the need for balance in the context of how much and what kind of public use to allow on conserved lands. In this matter - anthropogenic disturbances to the ecological resources, the question is always, What is too much disturbance? No single answer to this question applies across the board and often it's not known until it's too late, but clearly one instance of when it's too much is when it's visible, expansive, unauthorized, and it occurs on land that is needed for sensitive species and plant communities to persist. Also clear is that, while human "access provides an opportunity to connect local communities to the land, it should not come at a cost to sustainable management" (Alegria, 2015, p. 2). There comes a tipping point with damage, fragmentation or otherwise, that the habitat value of a conserved area is so compromised that it may no longer warrant being considered conserved for the purposes of NCCP/HCPs.

Throughout this discussion, the California Department of Fish and Wildlife (CDFW) is a proxy for public agencies that manage conservation lands.

A Societal Conundrum

CDFW is at fault for not preventing the creation, proliferation, and use of unauthorized trails and TTFs on its lands. The question is, Why does CDFW not better manage its lands when its mission places conservation above the public's needs?[29] Several of the articles reviewed assert that publicly conserved lands and/or the wildlife they support benefit the economy and the surrounding human populations. For example, Reed et al. (2014) state, "Wildlife provides significant economic benefits to the State of California through recreation, tourism, and commercial harvest" (p. 21).

What about the converse? Does our society or, more pointedly, do all users of conserved lands (as defined in footnote 9) somehow benefit the ecological resources enough to ensure that they are protected (i.e., experience ongoing necessary management and enforcement)? Often accompanying assertions such as the one above are statements that public access is necessary to cultivate knowledge

29 The mission of the CDFW is to manage California's diverse fish, wildlife, and plant resources, and the habitats upon which they depend, for their ecological values and for their use and enjoyment by the public.

about and appreciation for the conserved lands and thereby garner support for them. Are such assertions and statements meant to engender a sense that the advertised economic benefits in turn effect commensurate fiscal reciprocity for protection of the lands and the species they support? Regardless, they seemingly represent a disconnect – there is no such reciprocity, no positive linear relationship between degree of public use and commensurate users' support (i.e., dollars).

"Fishing and hunting programs and related conservation efforts have specific dedicated funding derived from licenses, fees, and taxes on outdoor equipment. The public-trust duties of CDFW and its conservation programs that broadly benefit species, habitats, and ecosystems warrant funding from **all** Californians" (CDFW, 2015, p. 7-23, emphasis added).

It is indubitable that hunters and fishers pay their fair share towards conservation thanks largely to the federal excise taxes imposed nationally since 1937 on hunting and fishing equipment and to the license, stamp and tag fees paid nationwide for hunting and fishing. The taxes have generated over $10 billion for wildlife conservation nationwide and the fees currently generate roughly $80 million annually in California alone; the latter paying for the vast majority of the state's wildlife conservation and research efforts licenses (CDFW, 2015). There are also the revenues generated from fees that all users pay for national, state, and local parks and forests that charge an entrance fee; these revenues are notoriously insufficient for the management of the lands.

There are also the revenues from the federal Land and Water Conservation Fund (LWCF) established by Congress in 1965. The majority of these revenues come from royalties paid by energy companies drilling for oil and gas on the Outer Continental Shelf (OCS). The LWCF provides funding for the U.S. Fish and Wildlife Service's (USFWS) State and Tribal Wildlife Grants (i.e., SWGs) and the USFWS's Cooperative Endangered Species Conservation Fund (i.e., section 6 under the federal ESA) among other programs (Vincent, 2016).[30]

Fervent accolades are deserved by those with the foresight to take the actions necessary to dedicate to conservation the revenues from the hunters, fishers, and oil and gas royalties – these are critical to conservation as are the entrance fees, but they are not enough. The bottom-line question is, if publicly conserved lands and the biota dependent on them are so economically important, why are the agencies responsible for protecting them chronically underfunded? This is a societal conundrum way beyond the scope of this Primer. Certainly, lack of sufficient public interest and concern yields lack of political will to adequately fund conservation.

A Case Study of Chronic Underfunding

Regardless of the reasons for the CDFW's chronic underfunding, the California's State Wildlife Action Plan (CDFW, 2015; SWAP) explains candidly CDFW's fiscal challenges and constraints.[31] The fiscal shortfalls of managing the conserved lands in San Diego County are a microcosm of the same at the statewide, national, and international levels. "USFWS, BLM, USFS, the National Park Service, and California State Parks have similar challenges to fund the restoration and management of wildlife areas, parks, and other wildlands" (CDFW, 2015, Volume 1 p. 7-24). "[M]any public agencies have limited resources for monitoring recreational use and enforcing compliance with management policies (Forrest & St. Clair 2006)" (Reed & Merenlender, 2008, p. 153).

30 The LWCF has to be reauthorized by Congress every three years. The current reauthorization expired on September 30 of this year. The weblink is to timely related information. https://www.lwcfcoalition.com/press-releases/

31 Information about the SAWP is available via the following weblinks. https://www.wildlife.ca.gov/SWAP https://www.wildlife.ca.gov/SWAP/Final This includes appendices. https://www.wildlife.ca.gov/SWAP/Final/Companion-Plans

CDFW is the state agency charged with conserving and restoring wildlife and ecosystems in California, responsibilities that have expanded and become more complex over the last several decades; the agency "manages wildlife areas, ecological reserves, and wildlands specifically for the benefit of wildlife and important habitats" (CDFW 2015, Volume 1 p. 7-24).

Appendix III provides excerpts from the SWAP that comprise the minimal essential reading for anyone who wants to understand CDFW's fiscal challenges and constraints – the reality hits hard. The following excerpts from the SWAP aid in the most basic understanding CDFW's fiscal reality.

1. The wildlife areas, ecological reserves, and wildlands "are a cross section of California's remarkable natural diversity of animals, plants, habitat types, and ecosystems. Some of the state's finest-quality wildlife habitats are represented in these holdings. But acreage of lands managed by CDFW has quadrupled in the last 35 years, from 250,000 acres in 1980 to over 1.1 million acres today, and funding to manage these lands has not kept pace. Major bond acts and some appropriations have funded acquisition of new lands for wildlife, but there is not a corresponding source of funding to maintain, restore, and manage these lands. Land management entails providing site security, managing public health and safety on the lands, managing wildlife and natural resources, maintaining infrastructure, and managing recreation and other uses" (CDFW, 2015, Volume 1 p. 7-24; emphasis added).

2. "The problem of inadequate funding for wildlife conservation has been 40 years in the making" (CDFW, 2015, Volume 1 p. 7-15). "The fiscal difficulties of CDFW have been repeatedly acknowledged by the Legislature but not solved" (CDFW, 2015, Volume 1 p. 7-21).

3. "Success or failure to conserve California's wildlife may well hinge on the level of funding dedicated to wildlife conservation and restoration programs over the next few decades" (CDFW, 2015, Volume 1 p. 7-14).

4. "Without a broad-based reliable funding mechanism, CDFW is hard-pressed to implement many of [its] conservation programs, even at modest levels. Resource assessment, conservation planning, and dozens of tasks necessary to conserve wildlife species at risk are severely underfunded" (CDFW, 2015, Volume 1 p. 7-15).

5. "Without management, wildlife values of the lands are… compromised [and] ecosystems functions are not maintained. Lacking restoration efforts and/or management, many acquired lands do not meet the habitat goals for which they were purchased" (CDFW, 2015, Volume 1 p. 7-24).

6. "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 and one staff person per 10,000 acres. Many lands were operated at $1 per acre, with no dedicated staff" (CDFW, 2015, Volume 1 p. 7-25). In SD County, CDFW has three land managers in the field responsible for managing 50,000 acres.

7. "California's Environmental License Plate Fund Program generates funds for environmental and natural resources departments; however, these funds are usually appropriated to CDFW **in lieu of** General Fund dollars rather than to augment the base budget" (CDFW, 2015, Volume 1 p. 7-25; emphasis added).

Though the SWAP recognizes that all recreation on conserved lands is a stressor on the ecological resources they support, the distance is vast between recognition of the need for, and the implementation of, effective long-term protective action against the stressor. Indicative of this is the San Diego Mountain Biking Association's (SDMBA) webpage about nine of CDFW's Ecological Reserves (ERs) and one of its Wildlife Areas in San Diego County (https://sdmba.com/cdfw_lands_and_trails_access.php); this Primer discusses this further on page 54, Appendix IV.

Given the Inadequate Resources, What are the Priorities?

Despite the continuously sequential listing of the Priorities in this Primer, there is no need to implement them sequentially. Though the Priorities constitute the minimum of what is needed to deal with the unauthorized mountain biking activities, capacity for their implementation is not presumed.

These are suggested Priorities for consideration to address the unauthorized trails and TTFs on conserved lands in San Diego County, with emphasis on CDFW's lands. Again, CDFW is a proxy for all public agencies that own and manage conserved lands. Many of the Priorities warrant, if not require, conferring with CDFW or both Wildlife Agencies (i.e., CDFW and USFWS) as to their validity and potential **before** further consideration.

PRIORITY 1 Determine What Can be Done to Augment CDFW's Budget for Conservation.

Confer with NGOs, CDFW, and others that may have a pulse on efforts underway to bring to CDFW's budget revenue earmarked for staff and resources for management of and enforcement on its conserved lands. For example, "[i]f California followed the Missouri and Arkansas examples and enacted a one-eighth of a percent surcharge on sales tax, it would generate about $650 million for wildlife conservation and management of natural resources" (CDFW, 2015, Volume 1 p. 7-26). The SWAP describes other potential funding mechanisms on page 7-26.

Look into the SWAP's statement that, "State and federal wildlife and land management agencies and some state policy-makers have expressed great concern for the lack of resources for wildlife conservation, restoration, and enforcement on public lands" (CDFW, 2015, Volume 1 p. 7-24, emphasis added).

a. What exactly does this mean?
b. Does CDFW promote and/or assert itself to those who need to listen (e.g., elected officials)?
c. Has CDFW taken a political approach – lobbying, etc.?
d. What are the impediments?
e. Is there active opposition, and if so, by whom and why?
f. Is CDFW pursuing any of the funding mechanisms discussed in the SWAP?The SWAP provides no insight to the steps that CDFW is taking or will take towards resolving the fiscal shortfall. The SWAP's Consumption and Recreation Uses Companion Plan (CDFW, 2016) states, "To support wildlife conservation programs, both SWAP 2005 and SWAP 2015 recommended implementation of recreation fees and taxes beyond fishing and hunting licenses that would allow non-consumptive recreationalists to contribute to conservation and management of the resources they use and enjoy (CDFG 2005; CDFW 2015)" (p. 5). Though the SWAP identifies several sources of fees and taxes, the author is unable to find any firm commitment in the SWAP to CDFW pursuing and such fees or taxes.

The understandable lack of traction the Wildlife and Habitat Conservation Coalition's (WHCC) Regional Funding Source committee experienced in its work to identify a long-term regional funding source for

most of the NCCP/HCPs in San Diego County may in some people's minds beg the question, How likely it is that there will be a viable way forward for a statewide effort to address the fiscal shortfall in CDFW's budget for managing and protecting its conserved lands? But, these are two entirely different sets of circumstances, though neither simple to navigate.

Others may readily dismiss PRORITY 1 as a pie-in-the-sky suggestion unworthy of any more thought. But, if there is any appetite and wherewithal to summon energy and time enough to work on this at the State level, it would be wonderful if the chasm were closed among people usually on the same side but on the opposite side in the case of SANDAG's 2016 Measure A, so that they can collaborate on this (not blaming here). One advantage of CDFW's fiscal shortfall is that it involves no incompatible interests (e.g., road construction versus habitat acquisition and management). Another advantage is the results of the mid-term election, Orange County included; this may be a good time to pursue this.

PRIORITY 2 Make Preventing and Stopping Unauthorized Activities a Priority

An important component of long-term management on conserved lands is regularly conducted monitoring to /assess whether authorized recreational uses on existing designated trails should be curtailed (e.g., seasonal restrictions, outright prohibitions) or could be expanded. Were there unlimited resources (i.e., fiscal, personnel – land managers, enforcement personnel) available, this would be a priority for CDFW's lands. But, until resources are not so very limited, it seems the priorities for managing recreational activities on lands seriously damaged by creation and use of unauthorized trails and TTFs ought instead to be:

a. preventing and stopping unauthorized activities (including the creation and use of unauthorized trails and TTFs) on conserved lands where they are prohibited;
b. restoring the areas damaged by unauthorized trails and TTFs : Priority 4.

The ultimate goal for Reed et al.'s (2014) project "was to generate a plan for a longer-term monitoring effort using a scientific framework to examine the potential impacts of recreation on wildlife species across the NCCP reserves." They state "**[p]rior to** making any changes in how recreation is managed, systematic monitoring of its direct and indirect effects on wildlife species must be conducted to inform the trade-offs inherent in multiple- use management of protected areas. This monitoring effort will generate an improved understanding of how recreation use may be affecting reserve performance for Covered Species in the [MSCP] and/or CDFW Species of Special Concern (SSC) and support adaptive management to ensure species persistence and ecosystem function across the NCCP reserve network" (Reed at al. 2014, p. 21; emphasis added). Even if the comprehensive monitoring effort contemplated by Reed at al. were ready to be deployed with all its requisite funding and personnel lined up, the need is urgent to first stop the damage caused by the unauthorized access and activities on the conserved lands, and the first step towards meeting that need is Priority 3.

PRIORITY 3 Seek Funding to Map the Unauthorized Trails & Restore the Damaged Plant Communities

To potentially avail the problem of unauthorized trails and TTFs to the funding needed to address it, and to make a cogent case to elected officials and others about the need to address them (the proliferation of unauthorized trails possibly being the most visible evidence of the lack of a long-term regional funding source), it's important to formally document the anecdotal observations (albeit, some very well documented) of the trails and their associated damage. To accomplish this and address the gap in information available about unauthorized trail creation and use, obtain funding for a study to:[32]

32 Possible sources of funding may (key word) include grants via the following programs: LAG, traditional Section 6, SWG (no 2019 grant cycle), and TransNet EMP. The LAG Program Proposal Solicitation Package for FY 2018-19 states, CDFW "seeks

a. map the unauthorized trails and TTFs – Davies and Newsome's (2009) approach may be useful in this exercise;
b. provide an analysis of the resulting fragmentation and its local ecological consequences;
c. provide an assessment of the best approach for restoration for each unauthorized trail or trail system (e.g., should the restoration be passive, active, or a combination);[33]
d. provide an estimate of the cost of restoring the areas damaged by the unauthorized trails and TTFs (or, preparing those areas suitable for passive restoration), including a 5-year post planting monitoring period (or whatever period of time is suitable);
e. provide estimates of the costs for the (1) purchase and installation of remote cameras within the restoration area to facilitate monitoring human activity - Burger (2012) states, "[r]emote cameras remain the most cost-effective method currently available to monitor wildlife activity" (p. 98), and (2) collection and analysis of the camera capture data; and
f. provide a comparison of these costs with the cost of the management and/or enforcement that would have been necessary to prevent the unauthorized activities.

Beyond "a" through "d," further research on the ecological impacts of unauthorized trail and TTF creation and use may be useful, but not at the expense of their restoration, management, and enforcement to prevent more – these should be the priority. An example of needed further research is an analysis of the ecological consequences of the additional fragmentation with explicit consideration of NCCP/HCP-covered species. "[M]aintenance of habitat fragments in urban areas is of conservation benefit to some animal species despite human activity and disturbance; nevertheless, it is crucial that conservation efforts focus on large reserves and avoidance of further fragmentation" (Markovchick-Nicholls et al, 2007, p. 9).

PRIORITY 4 Restore the Plant Communities Damaged by Unauthorized Trails and TTFs

A. Publicize the costs of the work conducted under Priority 3 and this Priority (F. Landis, personal communication, email dated July 30, 2017).
B. Use the outcomes of the study described in Priority 3 to obtain the funding needed:
   a. to restore the areas mapped;
   b. to purchase and install the cameras; and
   c. to collect and analyze the camera data.
C. Implement the restoration after installing the cameras.
D. Accommodate concerned citizens' assistance with the restoration. This might include a trained volunteer contingent that manages the cameras or members of SDMBA's backbone – the Local Stewardship Teams SDMBA (https://www.sdmba.com/local_stewardship_teams.php); it would be wonderful if SDMBA would rally their LSTs to assist with restoring the habitat removed by unauthorized trails on areas where biking is prohibited; they've done it at least once before (refer to footnote 40).

---

proposals for highest priority projects associated with NCCP implementation, including management and monitoring as well as **critical targeted studies**" (emphasis added - https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=6367&inline); does this Priority constitute a "critical targeted study?" It's too late to apply for the current cycle of funding, but not too late to start preparing to apply for the next cycle. Ann Van Leer maintains an impressively comprehensive spreadsheet of these and other funding sources, some others of which might fund this work.
https://www.wildlife.ca.gov/Conservation/Planning/NCCP/Grants https://www.wildlife.ca.gov/Grants/State-Wildlife-Grants

33 Here, restoration includes remediation and encompasses both building back and stabilizing the damaged or destroyed terrain and soil AND restoring the affected plant communities.

PRIORITY 5 Develop a Database of Designated Trails

If it doesn't already exist, it might be useful to develop a comprehensive database of all the designated mountain bike trails in San Diego County, with trail names and the following metadata at a minimum): design - single- or multi-track; jurisdiction - local, state, and/or federal; name of park/location; length of trail; style of trail, etc. Without this information, it's not possible to (a) point bikers to it as a resource, (b) inform bikers that ONLY these trails are designated, (c) assess if and where more trails or longer trails are legitimately needed, and (d) respond with anything other than, How many do you need? to someone like SDMBA's Trails Coordinator (SDMBA's Board Vice President at the time) who acknowledged that rogue bikers' behavior is wrong and illegal, but that it will continue until there are adequate opportunities for biking (B. Stone, personal communication, March 28, 2018, phone call).[34] At minute 6 remaining of the video at https://www.facebook.com/SDMBA/videos/vb.71076071171/10155092539971172/?type=2&theater, an audience member mentioned that he is creating a database of all the trails in San Diego County; his name was not audible. Some of the mountain biking websites offer information on trail locations etc., but many of the trails are unauthorized.

PRIORITY 6 Investigate the Possibility of Creating an NGO that Mirrors the NCC

Please pardon any naiveté or ignorance this suggestion may represent. The Natural Communities Coalition (NCC) (refer to https://occonservation.org/about-ncc/), based in Irvine, in Orange County, CA, is a 501(c)(3) nonprofit charitable organization whose Board of Directors consists of the Wildlife Agencies, and public and private landowners participating in and benefiting from the OC NCCP/HCP. The main purpose of NCC is to coordinate the land management, monitoring and research with our partners across the nearly 38,000-acre Reserve System of the OC NCCP/HCP. Their conservation efforts are supported by endowment income, grants from public agencies, and contributions from individuals and corporations.

The NCC's 2017 Annual Report (https://occonservation.org/wp-content/uploads/2018/11/2017-Annual-Report-v2-reduced-size.pdf) provides no information on charitable contributions received. It would be interesting to know if NCC receives such contributions from the public, expressly since large areas of the Reserve are closed to public access much or all of the time.

Education

Patten et al. (2017) identify (1) a need to understand visitors' (i.e., mountain bikers here) perceptions, values, and judgements, and (2) a need for visitors to understand the genesis for the lands conserved under the NCCP. The results of surveys of 640 backcountry trail users point to the need to correct the public's perceptions (i.e., ranging from no recognition to underestimations) about their impacts on wildlife (Taylor & Knight 2003). Addressing the disconnect between some mountain bike riders' perceptions and the reality of environmental impacts associated with mountain biking, Quinn & Chernoff (2010) suggest the need for management of not only the impacts but also the perceptions thereof. "[U]sers need to appreciate that the core function of protected areas is conservation of flora, fauna and landscape and the promotion of natural values and experiences" (Davies & Newsome 2009, p. 10).

34 The term "rogue" is introduced in Appendix IV.

Is it possible for education[35] alone to effectively address these sentiments with mountain bikers who (a) create and use unauthorized trails and TTFs, (b) are disinterested in, if not downright resentful of, prohibitions or restrictions on mountain biking (as reflected in behavior, verbal communication, blog posts), (c) are unwilling to accept that some conserved lands are not open to mountain biking and that some prohibit all public access, and (d) are openly hostile towards land managers and enforcement personnel?

In their article about a study conducted by the City of San Diego on the 866-acre Del Mar Mesa Preserve DMMP) to determine whether CDFW Wardens conducting enforcement is an effective method to curb unauthorized trail uses, Greer, Day, & McCutchen (2017) cite work by Park, Manning, Marion, Lawson, and Jacobi noting decades of research indicating that a combination of soft (i.e., education) and hard enforcement (i.e., warnings, citations, arrests, confiscation of bikes) is the most effective approach to promoting compliance. Greer et al. (2017) and SANDAG (2015) make the point that education becomes less effectual in areas with chronic unauthorized trail creation and use.

Prior to the study involving the CDFW Wardens, City Park Rangers had conducted regular educational efforts in the field (e.g., an average of 3-4 times monthly over a 17-month period), including access control (barriers and fencing). Salient outcomes from the Rangers' educational efforts include the following (SANDAG 2015, Greer et al., 2017):

a. despite the efforts, Rangers were unable to keep up with the vandalism of signs, and it became cost-prohibitive to use official metal signs;
b. the Rangers' jobs changed from natural resource management to law enforcement;
c. open space violations continued to increase and were "believed to be adversely affecting the species and habitats that the Preserve was intended to protect" (SANDAG, p. 4); and
d. non-compliance became the social norm as more users followed expanding numbers of unauthorized trails.

Given the level of unauthorized mountain biking activity on the DMMP and the lack of evidence elsewhere that providing more trail alleviates recreational pressure on unauthorized trails, it is unfortunate that the "the City is attempting to open more trails to mountain biking while balancing the needs of the wildlife in the area" (SANDAG 2015, p. 18). This is tantamount to rewarding bad behavior, an unfortunate precedent and certainly inconsistent with the well documented and proven precepts of behavior modification – reward the behavior you want and ignore the behavior you don't, unless it requires intervention, as in this context with enforcement. The outcomes of the CDFW Wardens' enforcement are reported on page 29.

PRIORITY 7 Become More Familiar With Mountain Bikers

This discussion and the following actions presume an interest in educating mountain bikers, which, to do effectively, calls for taking on Patten et al.'s first point - the need to understand visitors' perceptions, values, and judgements.

A. Consider A Bit About Mountain Bikers' Behavior: the Good and the Bad
Refer to the discussion in Appendix IV.

B. Monitor Local Mountain Biking Social Media Forums

35 Here, education refers to: (a) user education in the field, at community meetings/public events/presentations, and at points of sale of outdoor recreational merchandise; (b) education through media, flyers, websites, and blogs; and (c) regulatory, directional, and interpretation signage.

"Social media forums [provide] excellent insight not only into the mountain biking community, but also into how quickly user behavior changes [occur] and if those changes reflect a larger change in social norms towards use of illegal trails" (Greer et al. 2017, p. 61). This proved to be the case for the study conducted on the DMMP (SANDAG 2015; Greer et al. 2017), and for the City of Carlsbad's and this author's monitoring of the forums. These experiences reinforce that WHCC should have someone who regularly scours the biking on-line forums. SDMBA membership may be required for full access to SDMBA's Forum at https://www.memberleap.com/members/forum/board_list.php?orgcode=SDMB; information about membership for $39 annually is at https://www.memberleap.com/members/memberinfo/alt_entry1.php?org_id=SDMB. SDMBA's Facebook page at https://www.facebook.com/SDMBA/ is also a good resource, as are the websites at https://www.trailforks.com/?scope=nearby and https://www.singletracks.com/mountain-bike/trails.php.[36] Other websites to comb are the Southern California mountain biking forum (www.Dirttreaders.com) and a national mountain biking forum (www.Mtbr.com) (Greer et al., 2017).

C. *Attend SDMBA's Monthly Advocacy Meetings*

Meeting information is at https://www.memberleap.com/members/calendar6c_responsive.php?org_id=SDMB. SDMBA's Advocacy Meeting Minutes are at - https://sdmba.com/advocacy_meeting_minutes.php. This relates to Priority 14.

D. *Be Open to the Possibility of Cultivating Liaisons*

Occasionally, the social media forums provide glimpses into potential opportunities for well-known and respected mountain bikers to cultivate positive liaisons between the NGO environmental community and the larger mountain biking community. Refer to related Priority 8I on page 28 and "e" through "g" on page 30.

PRIORITY 8 Explain the Core Function of the Conserved Lands to the Mountain Biking Community

This discussion and the following actions respond to Patten et al.'s second point – a need for visitors to understand the genesis of the lands conserved under the NCCP. It's uncertain that it's feasible to meet the previously cited authors' guidance (i.e., shaping public perception about and cultivating an appreciation of the core function of conserved lands) to an extent great enough to effect significant benefits for conserved lands. It's even less certain that efforts to this end for rogue bikers will realize on-the-ground benefits, especially on those lands where mountain biking is prohibited. The difficulty experienced to date in working with SDMBA on the issue of unauthorized mountain biking activity on conserved lands where biking is prohibited underscores this. Nonetheless, the objective of the education would be to inculcate a respect for plants and wildlife to the point that the respect is internalized, thereby combatting self-interested behavior (refer to page 57, Appendix IV).

A. *Be Prepared for a Long-term Commitment & Coordination with Enforcement Efforts*

Assuming that this Priority is a worthwhile pursuit, despite the foregoing narrative, its implementation will require a continual effort over the long term to many audiences in several ways and in several venues / outlets. Coordination with enforcement efforts will be key.

B. *Reach Beyond SDMBA*

The implementation will require reaching the mountain biking community outside of SDMBA because SDMBA's membership of 1,100 pales in comparison to the 100,000 mountain bikers in San

36 A good example of valuable information to be gleaned from such resources is the video at https://www.facebook.com/SDMBA/videos/vb.71076071171/10155092539971172/?type=2&theater – SDMBA's October 23, 2017, 2-hour Advocacy Meeting (minutes of the meeting are at https://sdmba.com/october_2017_advocacy_minutes.php). There, U.S. Forest Service, Descanso District Ranger (Cleveland National Forest), Bob Heiar, with a background in outdoor recreation and trails management, states "I am very passionate about recreation management – that's what I really wanted to get into." The first part of the meeting is about Anderson Truck Trail (https://sdmba.com/anderson_truck_trail.php). He mentions the need to balance recreational activities with the needs of threatened and endangered species.

Diego County (B. Stone, personal communication, March 28, 2018, phone call). Even if SDMBA had control over its members' behavior (which they don't) and succeeded in convincing the rogue bikers to stop their unauthorized activities, rogue bikers outside of SDMBA would continue the unauthorized activity.

C. Use the OC NCCP/HCP Program as an Illustration

- In explaining the importance of prohibiting some or all human access to the ERs (or, any conserved lands) it might be helpful to use the OC NCCP/HCP Program as an illustration. In that Program, the 38,000-acre Reserve System is composed of many parcels of land combined to form several large corridors. Portions of the Reserve are always closed to public access except through docent-led tours. Other portions are managed-access areas for which guidelines "have been adjusted to cluster or zone human activities, to limit nighttime activity and the number of high-use days in sensitive areas, to enact and enforce rest periods immediately after high-use days, and to set recommended maxima for visitor numbers per day… [E]ffective management of human access over time is essential to sustain natural communities and wildlife dynamics and to provide high quality visitor experiences on these lands in perpetuity" (Patten and Burger, 2018, p. 239).[37]
- Emphasize that it is a privilege, not a right, to bike on the conserved lands where biking is allowed.
- Explain that the high level of management provided for the OC NCCP/HCP Program Reserve System is possible because of the funding mechanism established for it (refer to Priority 1).

D. As Simply Stated as Possible

The lands conserved pursuant to NCCP/HCP programs are "payment" in exchange for the streamlined development process afforded developers via the programs. These lands are NOT available for further degradation, as is also the case for ERs and some other public lands. While some are open to human access, they belong primarily to the plant communities and species that occur there. Explicitly pertinent to the conserved lands within or adjacent to highly urbanized areas in southern California is the fact that they would likely be developed by now had it not been for the prevailing NCCP/HCP programs. For example, for conserved lands in unincorporated San Diego County alone, since 1998, the County, Wildlife Agencies, and private conservation partners have spent $186M on land acquisition. Between 1998 and the beginning of 2018, more than 32,000 acres have been added to the MSCP South County Subarea Plan Preserve through private mitigation or public and local/non-profit acquisitions (https://sdmmp.com/upload/SDMMP_Repository/0/s0twy5ch9j17rfmgb34vxz68npdkq2.pdf).

E. Incorporate the Information about Ecological Impacts in this Primer and the Cited References

This includes both the direct impacts and indirect impacts. Granted it's hard enough to convey to recreational users the direct immediate impacts of their activities on wildlife. Making the same point about indirect impacts is even harder, but it is important.

F. Incorporate Species-Specific Information for Locations Bikers Ride

Refer to page 57, Appendix IV. Examples are vernal pool species, thread-leaved brodiae, coastal California gnatcatcher, Quino checkerspot butterfly (Wikens, 2018), and burrowing owl (Kapono, 2018; https://www.sandiegoreader.com/news/2016/may/02/stringers-otay-mesa-squeeze-burrowing-owl/ , https://institute.sandiegozoo.org/species/burrowing-owl), all species which activities on unauthorized trails and TTFs could easily disturb or even kill.

G. Incorporate the Outcomes of the Implementation of Priorities 3 and 4

---

37 The Irvine Ranch Conservancy (http://www.irconservancy.org), a non-profit organization, manages the Reserve System – the lands where Patten and Burger's (2018) study occurred. The County of Orange and the cities of Irvine and Newport Beach own the lands that TRC manages. Not only is the management of the OC NCCP/HCP well funded compared to most of the NCCPs/HCPs in San Diego County (the latter relying on a yet to be identified long-term regional funding source), but the lands comprising the OC NCCP/HCP Reserve System are subject to various levels of restricted access from open access to access only during Wilderness Access Days to no access ever. the presumed effective management of these lands may be feasible.

H. Push for the Installation of Signage where Needed

I. Recruit Bikers to Spread the Word

As the educational efforts proceed, there may be bikers who step forward to actively assist in educating other bikers and fighting the rogue behavior that smears the reputation of the biking community at large; these kinds of liaisons are sorely needed.

PRIORITY 9 Influence Mountain Biking Advocacy NGOs' Financial Supporters

A. On the webpage at https://www.rei.com/stewardship/creating-access, REI highlights SDMBA as one of the local non-profits that it supports. The webpage states, "[SDMBA] is a nonprofit organization that works to improve and create more legal trails for all users. A $10,000 REI grant in 2017 helped build more than 80 miles of new trail in the Pamo Valley/Orosco Ridge area of the Cleveland National Forest. Mountain bikers, hikers, and equestrians will benefit from this project. This was their tenth REI grant." SDMBA's 2017 annual report at https://drive.google.com/file/d/1M3kpNIObfrz_YDEwexOjlhkg4ss5OjiQ/view lists its sponsors (p. 10), indicating that REI is one to the tune of $15,000. The post at http://sdmba.com/news_manager.php?page=14101 explains that the 2017 grant "will be used to partially fund the Pamo Valley - Orosco Ridge Trails Plan."[38]

   Approach REI and:

   a. inquire about the possibility of making a presentation to their mountain biking members about unauthorized trail and TTF creation and use in San Diego County (this assumes that REI has member meetings where this is possible);
   b. ask them to condition their grants to mountain biking advocacy groups with a requirement that the recipient groups (a) actively conduct mainstream /social media PR (i.e., on their website, facebook page, etc.) opposing unauthorized trail creation and use, and (b) encourage their members to assist with habitat restoration on lands damaged by unauthorized riding where bike is wholly prohibited;
   c. inform them that the "80 miles of new trail in the Pamo Valley/Orosco Ridge" have not been built, and that the environmental community is concerned about the proposed trail system; and
   d. inquire whether, as an IMBA supporter, REI also opposes H.R. 1349 as does IMBA – refer to the comments following the article at: https://www.rei.com/blog/cycle/thirty-years-of-trails-and-counting .

B. Write SDMBA's sponsors listed in their 2017 annual report (p. 10) at https://drive.google.com/file/d/1M3kpNIObfrz_YDEwexOjlhkg4ss5OjiQ/view asking that they do the same as "b" and offer to discuss the issue with them.

Education – Conclusion

Even if education eventually effects a beneficial change on the ground, it won't happen soon enough with respect to the ecological damage spreading daily on conserved lands from unauthorized trail / TTF creation and use. In the interim, something must be done to stop the damage. That is enforcement, always accompanied with education.

38 In a post at http://www.eccalifornian.com/article/san-diego-mountain-biking-association-rei-awards on July 17, 2014, "The San Diego Mountain Biking Association (SDMBA) recently received a $10,000 grant to fund three local projects. These locations are Noble Canyon in the Cleveland National Forest, the Cuyamaca State Park and Crestridge Ecological Reserve in El Cajon." The author found no evidence online of a grant in 2018 from REI to SDMBA.

Enforcement

Greer at al. (2017) state that previous studies "conclude that a successful, cost-efficient enforcement program would start with an education and outreach blitz and then integrate enforcement into regular traffic duties. Rood, Kraichy, & Carmen (1987) further state that an ongoing public information effort is key to '*enhance and maintain the public's perception of enforcement*' and retain a positive attitude toward the law" (p. 57).

Greer et al. explain that, in the study conducted on the DMMP, "[t]he perceived abrupt change from an uncontrolled recreation area to an actively managed natural habitat area, led to hostility even though it was preceded by months of education, signage and fencing" (p. 62; study description on page 25 of this Primer). It is understandable that recreationists are taken aback when enforcement occurs on lands where they have not experienced it, especially if they have never or rarely seen any land managers or enforcement personnel in the area. It is incumbent upon the landowners and managers to inform users of the use restrictions, which seems to have been done effectively prior to the enforcement phase of the DMMP study; but, even if there is inadequate education, recreationists' hostility is counterproductive to their interests. Furthermore, ignorance of the law is no excuse for the creation and use of unauthorized trails, just as it is not in driving, trespassing, or growing marijuana on public lands.

In the context of needing to maintain public support for conserved lands, some articles encourage no or minimal enforcement against unauthorized recreational activities so as to avoid adversarial relationships between the bikers and the land managers and enforcement personnel. This view ignores the reality that woefully inadequate management allows for unleashed unauthorized activities and their ecological and societal consequences to occur. Let's not mince words; the rogue element in outdoor recreation will always exist, just as it does in other sectors of our society. Rogue behavior is unlikely to be educated out of society. Enforcement will always be necessary to protect whatever target is under threat.

Some details follow about and **outcomes** from the study involving CDFW Wardens' enforcement on the DMMP follow (Greer et al., 2017):[39]

a. the enforcement period comprised 810 hours during a 12-week period in 2013, with a variable (i.e., unpredictable) schedule mainly on weekends and Wednesdays;
b. 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;
c. during the enforcement period, the Wardens had 327 contacts with the public, in which they educated users about authorized trail use (327), issued warnings for trespassing in closed areas (118), and/or wrote citations (140);
d. overall use of the Preserve decreased from 3538 users during the pre-enforcement period to 2204 and 1413 users during and post enforcement, respectively – with normalization, the overall trend showed a statistically significant decline in use from 68.0 users per day prior to enforcement, to 29.4 and 32.9 users per day during and after enforcement, respectively;
e. illegal mountain biking statistically significantly decreased 66.0% over the study period; from an average of 43.5 users per day prior to enforcement to 9.1 users per day post enforcement, while legal mountain biking remained the same at approximately 10 users per day;
f. other illegal use also decreased statistically significantly from 7.4 users per day to 3.5 users per day, while legal uses increased from 3.6 to 7.8 users per day;

39 SANDAG (2015) and Greer et al. (2017) acknowledge that there may be confounding factors that might account for the observed changes in use, but conclude that, "the very strong signal observed in the Study provides confidence that methodological challenges did not [interfere] with the stated research goals" (Greer et al. 2017, p. 62).

g. illegal mountain biking dropped quickly during the enforcement and stayed low during the 43-day post enforcement period, while the decline in legal mountain biking during enforcement recovered to pre-enforcement levels post enforcement; and
h. it is not known where the illegal bikers went.

Overall **conclusions** from the study follow verbatim or close to verbatim (Greer et al. 2017, p. 63).

a. Soft enforcement aimed at public education and redirecting social norms was not sufficient in curbing illegal trail use on the DMMP.
b. Open space enforcement by CDFW Wardens was determined to be an effective method of reducing unauthorized use on the DMMP.
c. The threat of sanctions (hard enforcement) has a more general utility and effectiveness in curbing non-compliance behavior than outreach to promote "awareness-of-consequence" of user actions (soft enforcement). Gramann et al. (1995) found that the soft enforcement mechanisms were more effective in rural outdoor recreation areas than in urban outdoor recreation areas.
d. The study agreed with Merry (2010) that social media has great potential to engage and educate the public on environment issues, and that this potential is far from being realized.
e. A social media component is recommended prior and during any future enforcement efforts to help educate and reduce misinformation and distrust of staff among recreation users. The responsiveness and volume of social media followers represents an untapped opportunity for targeted education and outreach.
f. Hendricks, Ramthun, and Chavez (2001), concluded that a peer group of volunteers were the most successful approach at encouraging prosocial behavior. This is a form of "community policing," which focuses on building ties and working closely with members of the user community. *[This approach was this author's aim in early 2018 for advocating for having two or three bikers at the pre-community meetings; the meetings never happened.]*
g. The authors believe that the use of social media combined with community policing can be a powerful tool to redirect user attitude, and subsequent behavior, through peer-to-peer education about environmental impacts, and to answer questions regarding authorized uses, and warn users of potential sanctions for non-compliance.

PRIORITY 10 If Priority 4 is Done, Provide Education and Enforcement Throughout

If Priority 4 is done, provide education and enforcement throughout the work, including the 5-year monitoring period.

A. Once the mapping component of Priority 3 is done, ask managers of conserved lands where mountain biking has caused the worst damage to consider issuing a joint letter to SDMBA and other mountain biking organizations involved locally that briefly summarizes the results of the mapping and the problems with unauthorized mountain biking activities (B. Tippets, personal communication, email dated July 31, 2017).
B. If collaborative liaisons with any mountain bikers have been cultivated, request their assistance in (1) educating users in the field about the Priority 3 research and Priority 4 restoration, and (2) protecting the area under study, including the remote cameras.

PRIORITY 11 Monitor the Outcomes of the Work Done Pursuant to the Carlsbad / SANDAG MOU

The MOU was to terminate on July 1, 2018. Whether it did terminate or was extended, what have been the lessons learned? Can they be generalized for application on other conserved lands? Will there be other such MOUs negotiated with Carlsbad or any other NCCP/HCP jurisdiction?

PRIORITY 12 Continue to Pursue Enforcement

As is clear from the study done on the DMMP, enforcement must be a strategy used to prevent and counter unauthorized recreational activities on conserved lands. A person of authority (land manager, ranger, warden, possibly volunteer) should be continually present on a variable schedule (e.g., 2 -3 days weekly for at least ½ day); the more this occurs the fewer enforcement actions will be necessary.

Very unfortunately, CDFW's Consumptive and Recreational Uses Companion Plan to the 2015 SWAP does not list enforcement as a priority strategy category for addressing problems associated with recreation (CDFW, 2016). Ask CDFW why.

What to Do About the Proposed Trails and Trail Systems of Concern

"There is growing pressure on government agencies to purchase additional land for recreation and to expand public access in existing protected areas" (Wells as cited in Reed & Merenlender, 2008, p. 148). Local land-use decision makers and elected officials need to address the demand for recreational opportunities, specifically mountain biking trails. A major concern is that there is no guarantee that providing 25, 50, or 100 more miles of trails for mountain biking in San Diego County will stop or slow down the unabated proliferation of unauthorized trails. The appetite for challenging single-track trails seems insatiable, the pressure relentless.

Rogue bikers' reaction to enforcement against unauthorized trail creation and use is often to shift their riding to other locations (Greer, 2017; B. Stone, personal communication, March 28, 2018, phone call). SDMBA speculates that there is a correlation between the enforcement on the Carlsbad Highlands Ecological Reserve and the uptick in the unauthorized biking activity in north county especially along the SR-78 corridor, including on lands owned and managed by the Escondido Creek Conservancy,[40] and that the activity will extend into Escondido & Valley Center (B. Stone, personal communication, March 28, 2018, phone call). Whether this speculation is correct is moot - this is just one illustration of the proliferation of the unauthorized activities. That this illustration seems to refute the claim that bikers want riding opportunities outside their front door is also moot (i.e., they <u>will</u> drive and ride) given that, regardless of what the riders want, the acreage of open space available in urbanized San Diego County will not be able to accommodate it. Even in less urbanized areas, "[t]he cold fact is that no new land is being produced in San Diego. Our growing population has to share shrinking resources, as do all the sensitive species that have already lost the majority of their population[s] to development" (California Native Plant Society - CNPS, California Chaparral Institute, Wild Zone Conservation League, 2018, p. 4).

Even at the geographic scale of open space the USFS works with, the USFS has difficulty in finding balance among the sometimes divergent needs of the recreationists with the "specific amount of acres" the USFS has to work with; the USFS can't be everything to everyone on every acre (USFS Descanso District Ranger, Bob Heiar, at minute 13 remaining in the video described in footnote 36).

While it is an unsavory to ponder rewarding the rogue bikers' protestations (e.g., reacting to enforcement by shifting their illegal riding elsewhere), there is no question that more land needs to be dedicated to mountain biking in San Diego County, but what Patten et al. (2017) articulate so well about the OC NCCP/HCP Program warrants close consideration: "Given the limited amount of contiguous open space within the Coastal Reserve and observed sensitivity of wildlife to human-presence, a cautionary

40 The webpages at the links below provide information about this vandalism.
https://www.sandiegouniontribune.com/communities/north-county/sd-no-bike-trail-20180411-story.html
https://www.nbcsandiego.com/news/local/Illegal-Mountain-Bike-Trail-Found-in-Escondido-Creek-Conservancy-475712043.html

approach to expanding human-activity beyond authorized trails and outside of already established sunrise to sunset activity envelopes should be taken" (p. 43). This caution is about a Reserve System that is far more rigorously managed than are the NCCP/HCP conserved lands in San Diego County, because of available fiscal resources – it pertains even more to the latter lands.

For the conserved lands, Reed and Merenlender's (2008) point merits thought for areas where it can be applied - "many public agencies have limited resources for monitoring recreational use and enforcing compliance with management policies (Forrest & St. Clair 2006). These limitations suggest that it may be more effective to allocate recreational uses and conservation targets among different sites, and this approach will require a diverse suite of land conservation strategies" (p. 153). One such area is the 2800-acre Crestridge Ecological Reserve where the mountain biking is restricted to a portion of the Reserve (refer to Appendix V for information about Ecological Reserves).

The question of how many miles of mountain biking trails to provide is beyond the scope of this Primer, but it is clear that any efforts to satisfy the demand require scrutiny.

PRIORITY 13 Request that Lead Agencies Reveal Negotiations with Mtn. Biking Advocates

Send a letter to all Lead Agencies to which this pertains requesting that they provide notification of substantive discussions and/or negotiations underway regarding mountain biking trails on or leading to conserved lands, both adding trails to existing systems and entirely new trail systems. With regard to such negotiations with SDMBA, implementing Priorities 7B and 7C should facilitate awareness of SDMBA's activities in this realm.

PRIORITY 14 Track and Comment on Proposals for New Trails

Track and comment on proposals for new trail systems or additional trails in existing trail systems on or leading to conserved lands. This Priority is not meant to impede the building of more trails on these lands, though further access may need to be disallowed or greatly minimized to meet the Priority's objectives, which are to (a) prevent undermining the lands' ecological integrity, and (b) ensure that the lands are meeting conservation obligations. One factor to examine for trails proposed on lands acquired with Section 6 funding are the commitments that govern the uses of such lands, which are "for the purposes of plant and wildlife habitat preservation, restoration, and management" (CDFW, 2018).

Participation in the CEQA and NEPA processes is essential and ideally begins way before a CEQA or NEPA document is circulated for public review, as recently occurred with the environmental community's involvement in the County of San Diego's proposed Public Access Plan for the Sycamore Canyon / Goodan Ranch Preserve. "[NCCPs/HCPs] are intended to provide long-term protection of multiple endangered species via mitigation for individual development projects, based on requirements of the federal [and California] Endangered Species Act[s] as implemented through the California Environmental Quality Act" (Reed at al. 2014, p. 3; emphasis added).

The NCCP/HCP programs embody a sound (perhaps the only) approach for biological conservation in urban areas - long-lived legally binding agreements negotiated to protect conserved lands in exchange for streamlined development affecting sensitive biological resources. However, the implementation of the NCCP/HCP programs in San Diego County has two achilles heels that undermine its efficacy; they are: (a) as alluded to elsewhere in this Primer, the inability to date to secure the regional funding source contemplated by most of the NCCP/HCP programs, and (b) the withering of the once stalwart jurisdictional stewardship of the programs that has occurred with turnover of elected officials and staff

of a few signatory jurisdictions. As to the second achilles heel, like all government-based programs across all sectors of society, the NCCP/HCP programs are vulnerable to the political winds of change; this is not unique to San Diego. Having once signed onto the quid pro quo on behalf of the development community, the jurisdictions are obligated to do their part to meet the conservation expectations. The implementation of CEQA is one arena where the few jurisdictions display their withering commitment, where it occurs to various degrees from innocent oversight to knowing blatant disregard for the requirements to implement the prevailing NCCP/HCP. This is the crux of the need for continual vigilance over these jurisdictions' CEQA processes for projects that may affect conserved lands.

No guidance is necessary here other than that the most effective comments reflect knowledge of or at least some familiarity with the requirements (NCCP/HCP or otherwise) that apply to a project. The Lead Agency can and will dismiss or explain away comments made with no relationship to the requirements. A case in point is the proposed Orosco Ridge Trail System – in additional to the federal environmental laws to which USFS projects are subject, the prevailing documents are the Cleveland National Forest Land Management Plan (https://www.fs.usda.gov/main/cleveland/landmanagement/planning) and the USDA Forest Service Strategic Plan (https://www.fs.fed.us/sites/default/files/strategic-plan%5B2%5D-6_17_15_revised.pdf). The USFS can easily dismiss or explain away comments made with no references to these plans.

Worthy of attention is a line of questioning that may seem unrelated to ecological concerns, but that are actually right on target with respect to management of the trails, their use, and unauthorized trails, especially in light of the USFS not having a budget for recreation (refer to page 58, Appendix IV), these are critical questions. From a CEQA comment letter on the proposed Orosco Ridge Trail System in the Cleveland National Forest, the questions follow.

> *Since it appears to be designed as a "world-class mountain-bike" destination, it is reasonable to ask how many people are predicted to use the Project trails. Is the number high enough to require additional facilities, such as a parking lot, toilets, water, even an upgraded road to handle car traffic to and from the trailhead? Are local fire, rescue, and law enforcement jurisdictions capable of handling the increase in incidents predictably generated by the proposed Project? All of these matter. Budgets are tight, and while SDMBA has a good record of maintaining trails, they lack the expertise or resources to deal with health, safety, and legal issues that will predictably occur in any heavily used area. Who will take care of the Project once it is built? Can they afford to care for people, maintain the trails, police the trails, and close unauthorized ones on a regular basis?* (CNPS et al., 2018. p. 3).

In the context of the Laguna Mountain trails that the USFS and SDMBA have been collaborating on, starting at 26 minutes remaining in the video at https://www.facebook.com/SDMBA/videos/vb.71076071171/10155092539971172/?type=2&theater, mention is made that the plan is for **100-foot wide corridors** within which the trails are aligned. This will allow for trail modifications and other such work as needed over time because of irreparable trail damage etc. to occur more easily and timely. It is inferred that the environmental analysis encompasses the entire area within the 100-foot wide corridor and that such work would be done without further environmental review – this requires clarification.

PRIORITY 15 Request that SDMBA Modify One of its Aims

One of SDMBA's aims is to "challenge current and future developments in San Diego County to provide… quality recreational features including natural surface trails to their projects" (https://www.guidestar.org/profile/20-1701837). Request that SDMBA modify this aim by directing it outside of conserved lands including lands serving as mitigation for development-related biological impacts.

PRIORITY 16 Encourage SDMBA & Other Mtn. Biking Advocates to Get Involved in North County MSCP

"Conservation planning should take into account not only the spatial distribution of species, but also the demand for recreational use and other human activities, and the compatibility of those activities with longterm conservation objectives" (Reed & Merenlender, 2008, p. 153).

Encourage the mountain biking community to get involved early on in the land use planning process, and work less outside the public process. Unfortunately, mountain bikers were not at the table when the approved NCCP / HCP programs in San Diego County were negotiated among many stakeholders over many years. Had they been, there might better appreciate their import.

If it's not too late, encourage mountain biking advocates to get involved in the North and East County plan planning processes.

PRIORITY 17 Track H.R. 1349 - Would Allow Biking in Wilderness Areas

If the bill does not proceed out of the House by year-end, the new House may have an opportunity to reverse its forward trajectory. It was IMBA's opposition to this bill that caused SDMBA to sever its relationship with IMBA. Below are links to pertinent webpages.

- https://www.congress.gov/bill/115th-congress/house-bill/1349
- status of bill: https://www.congress.gov/bill/115th-congress/house-bill/1349/all-actions?overview=closed#tabs
- http://www.sustainabletrailscoalition.org/#home
- https://www.conservationnw.org/news-updates/pushing-back-wheels-wilderness-bill/
- https://sdmba.com/sdmba_ends_chapter_affiliation.php
- http://sdmba.com/news_manager.php?page=15585
- https://wildernesswatch.org/keeping-wilderness-wild-blog-post/wilderness-intended-as-refuge-from-bikes-and-other-mechanization?eType=EmailBlastContent&eId=a1e25b1c-715d-48b4-af76-36c6a7e5a444

H.R. 1349 would "defeat the very purpose of setting aside and protecting" the Wilderness Areas (quote from webpage at last link above).

Acknowledgements

Not in relation to this Primer, but in general, thanks to my former co-workers at the U.S. Fish and Wildlife Service (2 years) and the California Department of Fish and Wildlife (12 years) for the knowledge I gained while working with them, primarily in the NCCP/HCP programs; thanks also to collaborators in other agencies, and in jurisdictions, academic institutions, consulting firms, and organizations who provide their expertise for the betterment of the plant communities and species we all care so much about.

References

Grey shading denotes grey literature, meaning not published in peer reviewed journals. Those with an asterisk (*) are written or contributed to by professionals employed in the fields of biology or ecology.

Alegria. N. 2015. Wildlife Response to Wilderness Access Days - Impacts on Abundance and Behavior. Irvine Ranch Conservancy. Included in the Patten & Burger 2017 Report.*

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

Berg, J. 2014. Paper for English 101 Class.

Bernard, G.E., W.F.D. van Dongen, P-G. Guay, M.R.E. Symonds, R.W. Robinson, 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.

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.*

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.*

_____2016. SWAP's Consumption and Recreational Uses and Companion Plan.*

_____2018. Letter from CDFW, South Coast Region, to County of San Diego, Department of Parks and Recreation, about Old Survey Road 97 Trail at Ramona Grasslands.*

Cheptou, P-O., Hargreaves, A.L., Bonte, D., Jacquemyn, H. 2017. Adaptation to fragmentation: evolutionary dynamics driven by human influences. *Phil. Trans. R. Soc. B* 372: 20160037. http://dx.doi.org/10.1098/rstb.2016.0037

City MTB. 2018. Is it time for mountain biking to put on its big boy pants? March 23, 2018. City MTB website. http://www.citymtb.org/home/is-it-time-for-mountain-biking-to-put-on-its-big-boy-pants

Ciuti, S., Northrup, J.M., Muhly, T.B., Simi, S., Musiani, M., Pitt, J.A., et al. 2012. Effects of Humans on Behaviour of Wildlife Exceed Those of Natural Predators in a Landscape of Fear. *PLoS ONE* 7(11): e50611. https://doi.org/10.1371/journal.pone.0050611

County of Orange 1996. Natural Community Conservation Plan and Habitat Conservation Plan: County of Orange Central and Coastal Subregion. Parts I & II NCCP/HCP. 25 pp. and 485 pp, respectively.*

_____1996. Implementation Agreement Regarding the Natural Community Conservation Plan for the Central/Coastal Orange County Subregion of the Coastal Sage Scrub Natural Community Conservation Program. 216 pp. https://occonservation.org/about-ncc/*

California Native Plant Society, California Chaparral Institute, Wild Zone Conservation League, Cleveland National Forest Foundation. May 24, 2018. Letter in response to the USFS's April 25, 2018, Scoping Letter about the USFS initiating a NEPA analysis for the Orosco Ridge Mountain Bike Trail System (File Code: 1950).*

Davies, C., Newsome, D. 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., Leslie, D.M. JR., Walter, W. D., Graber, A. 2010. *Mountain Biking Trail Use Affects Reproductive Success of Nesting Golden-Cheeked Warblers. Wilson Journal of Ornithology*. 122(3): 465-474.

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

Gill, J., Norris, K., Sutherland, W. 2001. Why behavioral responses may not reflect the population consequences of human disturbance. *Biological Conservation*. 97. 265-268. 10.1016/S0006-3207(00)00002-1.

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

Havlick, D.G., Billmeyer, E., Huber, T., Vogt, B., Rodman, K. 2016. Informal trail creation: hiking, trail running, and mountain bicycling in shortgrass prairie, *Journal of Sustainable Tourism*, DOI: 10.1080/09669582.2015.1101127

Kapono, C. 2018. Rare, Wild Owls Get Treated for Parasites.. *San Diego Union Tribune*. July 17, 2018.

Keltz, D. Jan. 23, 2018. Mountain-bikers don't want illegal trails either - Open-space protectors and riders do lap around compromise. *San Diego Reader* https://www.sandiegoreader.com/news/2018/jan/23/stringers-mountain-bikers-dont-want-illegal-trails/#

Larson C.L., Reed S.E., Merenlender A.M., Crooks K.R. 2016. Effects of Recreation on Animals Revealed as Widespread through a Global Systematic Review. *PLoS ONE* 11(12): e0167259. doi:10.1371/journal.pone.0167259

Lathrop, J. 2003. Ecological Impacts of Mountain Biking: A Critical Literature Review. *Wildlands CPR Report*. 11pp.

Marion, J.L., Wimpey, J. 2007. Environmental impacts of mountain biking: Science review and best practices. In P. Webber (Ed.), Managing mountain biking (pp. 94 111). Boulder, CO: International Mountain Biking Association.*

Markovchick-Nicholls, L., Regan, H.M., Deutschman, D. H., Widyanata, A., Martin, B., Noreke , L., Hunt, T. A. 2008. Relationships between human disturbance and wildlife land use in urban habitat fragments. *Conservation Biology* 22:99-109. [the version reviewed is pre-publication, dated 2007, and 11 pages long]

Monz, C.A., Pickering, C.M., Hadwen, W.L. 2013. Recent advances in recreation ecology and the implications of different relationships between recreation. *Front Ecol Environ* 2013; 11(8): 441–446, doi:10.1890/120358 (published online 29 Aug 2013)

Moore, D.A., Loewenstein, G. 2004. Self-Interest, Automaticity, and the Psychology of Conflict of Interest. *Social Justice Research,* Vol. 17, No. 2, June 2004

Naylor, L. M., Wisdom, M. J., Anthony, R. G. 2009. Behavioral responses of North American elk to recreational activity. *Journal of Wildlife Management* 73:328–338. [the version reviewed is pre-publication, dated 2008, and 11 pages long]

Patten, M., Burger, J. 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.*

_____2018. Reserves as double-edged sword: Avoidance behavior in an urban-adjacent wildland. *Biological*

Conservation. 18: 233–239

Pickering, C.M. Ten Factors that Affect Severity of Environmental Impacts of Visitors to Protected Areas. 2010a. *Ambio*. 39(1): 70-77

Pickering, C.M., Hill, W.H., Newsome, D., Leung, Y.F. 2010b. 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.

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

Quinn, M., Chernoff, G. 2010. Mountain Biking: A Review of Ecological Effects. Tech. Calgary: Miistakis Institute. Print.

Reed, S.E., Merenlender, A.M. 2008. Quiet, Nonconsumptive Recreation Reduces Protected Area Effectiveness. *Conserv Lett*. 1: 146–154

Reed, S.E., Larson, C.L., Crooks, K.R., Merenlender, A.M. 2014. Wildlife Response to Human Recreation on NCCP Reserves in San Diego County. Wildlife Conservation Society Agreement No / LAG #: P1182112.*

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

SANDAG. 2015. Del Mar Mesa Preserve Enforcement Project San Diego, CA.*

SDMBA. 2018. Building Unauthorized Trails Jeopardizes Access. https://sdmba.com/building_unauthorized_trails_j.php (article not dated; date is the date accessed)

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

Steven, R., Pickering, C., Castley, J.G. 2011. A review of the impacts of nature based recreation on birds. *Journal of Environmental Management*. 2011; 92: 2287–2294. https://doi.org/10.1016/j.jenvman.2011.05.005 https://www.ncbi.nlm.nih.gov/pubmed/21640470

Taylor, A.R., Knight, R.L. 2003.Wildlife Responses to Recreation and Associated Visitor Perceptions. *Ecological Applications*, vol.13 no.4, pp. 951-963.

Vincent, C.H. 2016. Land and Water Conservation Fund: Appropriations for "Other Purposes."

Weiss, F., Brummer, T.J., Pufal, G. 2016. Mountain bikes as seed dispersers and their potential socio-ecological consequences. *Journal of Environmental Management*. 181 326-332.

White, D.D., Waskey, M.T., Brodehl, G.P., Foti, P.E., 2006. A comparative study on impacts to mountain bike trails in five common biophysical regions of the south western U.S., *Journal of Park and Recreation Administration*, 24 (2) pp.21-41.

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

Wilkens, J. 2018. Recovery Plan for Endangered Butterfly Takes Wing in San Diego. *San Diego Union Tribune*. November 23, 2018.

APPENDIX I About the Articles Reviewed

Here, "articles" refers to all materials cited, whether grey or peer reviewed, and whether government documents, reports, academic/scientific papers, letters, newspaper articles, or blog posts. As is evident from the Primer, several online sources were also consulted; weblinks for most of these are only within the body of the Primer (i.e., not included in the references).

Among the 48 articles cited, 27 were peer reviewed and 12 of the 21 grey literature articles were written or contributed to by professionals employed in the fields of biology or ecology. Among the 48 cited articles, five (5) are government documents – these were not fully read.

Of the 36 recreation-related cited articles, 11 are about mountain biking only. The remaining 25 articles are about two or more recreational activities. Of the 11 about mountain biking only, five (5) are peer reviewed articles, two (2) are blog posts, two (2) are papers, one (1) is a newspaper article, and one (1) is a student's literature review. As with any topic, there are articles that present a particular normative position; in this case four (4) of the grey literature articles fit in this class – they are all about mountain biking only.[41] Given the impetus for this Primer, reading biased articles was appropriate and insightful where they revealed shortcomings in the authors' reasoning.

See page 12 for a breakdown of how the articles treat unauthorized trails.

Eighteen (18) of the 36 recreation-related cited articles discuss original research in the field, including making and analyzing observations of responses of target wildlife species to human disturbance, capturing and analyzing camera data, scat collection and analyses, track observations and analyses. Some of these 18 also involved literature reviews. The remaining 18 articles involved either literature reviews and /or general discussions about wildlife responses to humans. Many of the articles are about research done in rural or undeveloped areas that experience lower levels of recreational use than do urban settings.

Some citations in this Primer are to unread primary sources cited in the reviewed articles. Articles so cited are not listed as references. This is not ideal; the more acceptable approach is to use secondary sources sparingly, for instance, when the original work is out of print, unavailable through usual sources, or not available in English. But, one can read only so much

.

41 A "normative position" here refers to work that is not objective, but instead endeavors (whether or not consciously) to establish what the author(s) think ought to be considered the norm, or even the objective reality.

APPENDIX II Variables

Recreation ecology, similar to other kinds of field ecology, is fraught with the challenges of conducting statistically valid research (Quinn & Chernoff, 2010). Most studies are deficient in any number of ways: they may be too short in duration, not have adequate controls or replications, be anecdotal in nature, or have too many potentially confounding variables (Knight & Cole as cited in Quinn & Chernoff, 2010). The degree to which and how the biotic and abiotic resources present in any one location respond directly and indirectly to recreational activities depends on many variables, some of which may be confounding.

Figure I and the table following it reflect the complexity of researching recreation-related ecological impacts.

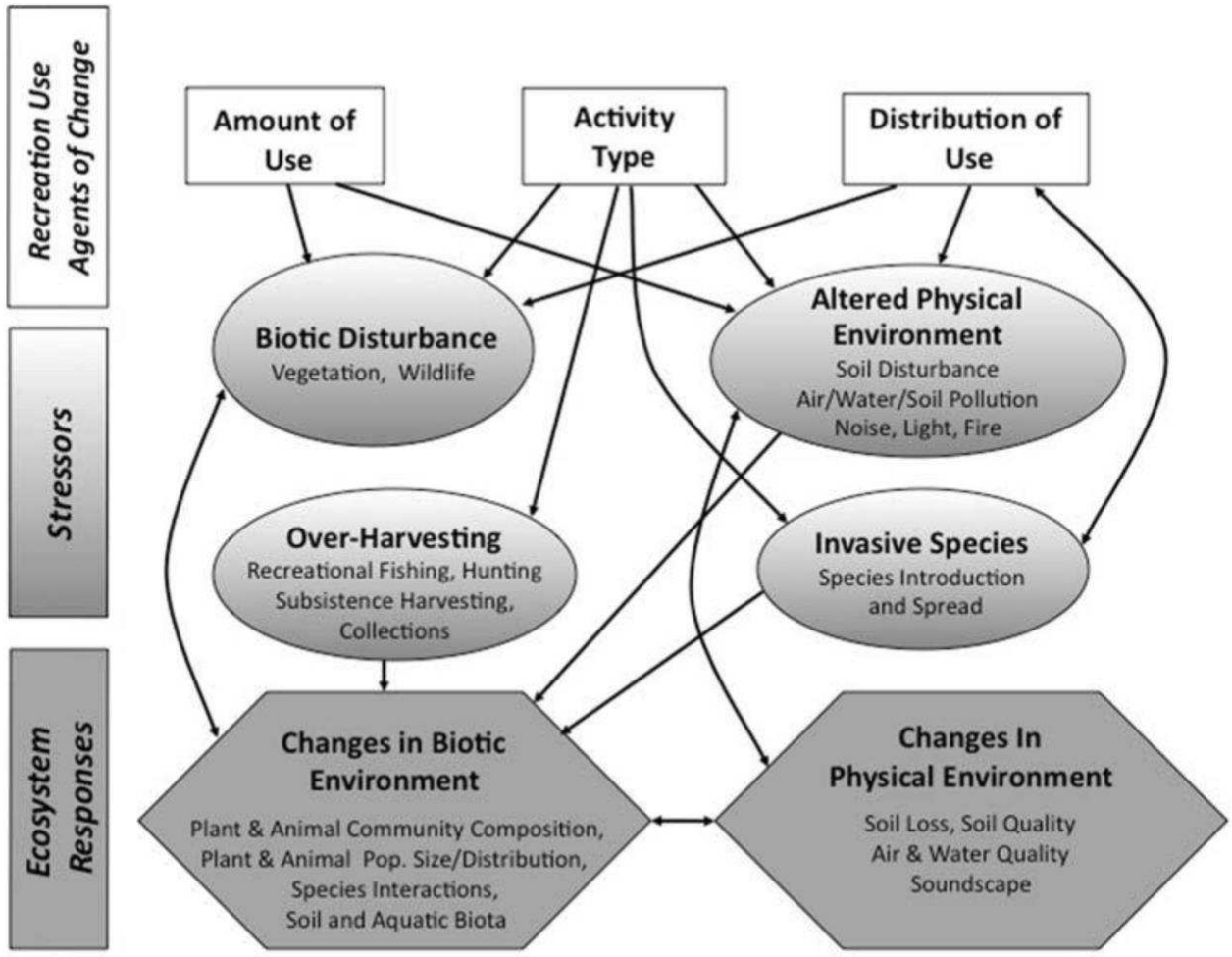

Figure 1.
A conceptual model of recreation-related ecological impacts (Monz et al. 2010 as cited in Quinn & Chernoff, 2010.

Variables that Influence the Outcome of Studies Designed to Assess the Ecological Impacts of Recreational Uses	
Compilation of factors identified as variables in one or more of the cited articles: Taylor & Knight 2003, Beale & Monaghan 2004, Markovchick-Nicholls et al. 2007, Quinn & Chernoff 2010, Burger 2012, Pickering 2010, and Davis et al. 2010.	
a. regional geophysical traits b. size(s) of preserve area(s) where research occurs c. vegetation present d. vegetative cover e. surrounding environment, including intervening vegetation 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 trail and the uses for which it was designed k. steepness of trail l. placement of trail (orientation to terrain - on flat, along a slope, across a slope) m. direction of trail (ascending or descending) n. spatial relationship between trail and target animals o. wildlife present, target and non-target p. total # of target wildlife individuals q. spatial distribution of target animals 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. degree of target animals' habituation to tested activities v. duration of target animals' exposure w. whether the target animals have the ability to retreat x. type(s) of recreation y. duration of recreational activity z. # of humans present (e.g., individual or groups)[42] aa. # of disturbances per day bb. whether recreational activity is on or off an official trail cc. recreationists' positions dd. angle of recreationists' approach ee. for biking - riding style (speed of travel, angle of travel) ff. whether the recreationists apply best practices gg. recreationists' behavior (e.g., talking or silent, continuous movement or stopping) hh. degree of human use ii. encounter distance jj. perpendicular distance kk. encounter x perpendicular ll. distance of recreational travel mm. researcher bias nn. study methodology (e.g., do recreationists approach wildlife directly or tangentially, on or off trail; includes statistical analyses)

The paragraph below further exhibits the complexity of recreation ecology.

> *Statistical analyses should examine alternative possible use-impact relationships (Monz et al. 2013) between recreation activity and detection of the target species to assess: (1) the impact of recreation activity relative to other known drivers of species occupancy, distribution, physiology, reproduction and survival (e.g., habitat fragmentation, invasive species); and (2) the relative importance of individual recreation activities (e.g., hiking, mountain biking) and local characteristics on the occurrence, community composition, and relative abundance of sensitive species* (Reed et al. 2014, p. 23).

42 "However, recreation impacts vary nonlinearly with use in a variety of ecosystems (for example, Cole 1986), such that a small number of visitors can have a disproportionate impact on sensitive species" (Reed & Merenlender, 2008, p. 153).

"Measuring the impacts of human activity on conservation targets is difficult because of the underlying spatial, diurnal, seasonal and even type variability of the indices being measured" (Burger 2012, page 96). "Wildlife responses to recreationists are likely influenced by a suite of variables that may change with each situation" (Steidl & Anthony as cited in Taylor & Knight 2003, p. 3). "Response of large and medium-sized mammals to human activity may be difficult to characterize because that response varies in time and space" (e.g., Vistnes and Nellemann as cited in Patten & Burger, 2018, p. 238) and with species and type of activity. Moreover, response is likely to depend on the level of human presence / activity that evokes a response, and to be species specific and subject to feedbacks and interactions with other factors (e.g., edge effects, availability of cover, exposure to disturbance, or time since fire) (Patten & Burger, 2018).

Referring to the responses of soils and vegetation to activity, Quinn and Chertoff (2011) explain that "this [nonlinear] relationship makes comparative assessment of the impacts of one type of use over another problematic" (p. 16).

"Since many of the environmental effects are known to vary according to regional geophysical traits, applying [to one location] research carried out in other biomes and landscapes may be problematic" (Quinn & Chernoff 2010, p. 23).

Study methodology (i.e., design, sampling, data collection, and data analysis – statistics, including modelling) itself encompasses many variables that dictate how other variables will influence the study outcomes (usually implicitly). Even if methodology is consistent among two or more studies, other variables can result in different study results (Taylor & Knight 2003). Methodological issues may limit the inferences that can be made from the results (Pickering et al, 2010).

Study design and statistical analyses can utilize methods to control for confounding variables (e.g., by using covariates), but controlling for all the variables listed in the figure and list above is challenging. If the experimental organisms are wildlife, there are a lot of confounding variables that are impossible to control.

The preceding discussion underscores why no broadly applicable and scientifically defensible conclusory statements can be made with respect to the relative impacts of recreational activities on wildlife. The single exception is that mountain bikers travel farther than hikers per unit time, and thereby generally affect larger areas and the wildlife they support.

APPENDIX III **Excerpts from *California State Wildlife Action Plan***

2015 CA SWAP Volume I : Section 7.3 - Resources Needed For Conservation Actions starting on p. 7-14. Some pages are intentionally omitted, only for the sake of brevity.

California State Wildlife Action Plan

2015 UPDATE

A Conservation Legacy for Californians

Volume I: Plan Update

September 2015

implementation. The companion plans are critical for prioritizing effective conservation strategies and activities for the species and habitats addressed in SWAP 2015 and identifying human and financial resources to support implementation. Together, SWAP 2015 and associated companion plans set a context and strategic direction of integrated planning and management efforts that will improve California's habitat and wildlife conservation.

The two main cross-cutting themes coming to light during development of the companion plans are integrated regional planning and climate change.. The three recurring priority strategy categories common among at least five companion plans are data collection and analysis, management planning, and partner engagement. The companion plans will be posted on the California SWAP website (https://www.wildlife.ca.gov/SWAP) when they are available.

SCGN: Species of Greatest Conservation Need

7.3 Resources Needed For Conservation Actions

Currently, the conservation actions described in the SWAP are carried out by many CDFW programs. While historically these activities were not specifically implementing the SWAP, the activities can now be considered part of this greater and more comprehensive effort. Additionally, CDFW receives and uses California's annual allocation of SWG funds to accomplish resource assessment and direct management actions for SGCN and their habitat. CDFW staff submit project proposals for review and scoring by a Technical Advisory Committee (TAC) composed of researchers and species experts throughout CDFW. The proposals are scored on a number of factors, including relevance to implementation of SWAP and technical merit. A Management Advisory Committee composed of program managers throughout CDFW reviews TAC results and recommends which projects should be submitted to USFWS for funding consideration.

7.3.1 Funding for Wildlife Conservation

Existing conservation programs and many of the conservation actions recommended in this plan require additional funding. Halting the slide of species toward endangered species status will require new research, expanded conservation planning and management, greatly increased species assessment and monitoring, and major habitat restoration projects. Success or failure to conserve California's wildlife may well hinge on the level of funding dedicated to wildlife conservation and restoration programs over the next few decades.

Increased Demands on Conservation Agencies by Growth and Development

Rapid growth and development, water diversions from creeks and rivers, invasions of non-native species, growth in off-road vehicle recreation, and numerous other activities that affect wildlife have demanded additional efforts of wildlife scientists and conservation managers.

With expanding development, California's unique habitats are shrinking. Maintaining healthy populations of species on fragmented and smaller areas of habitat requires more intensive management, environmental review, conservation planning, monitoring, mitigation project design, and habitat restoration work. Accompanying growth and development is an increasing demand by the public for recreational access to public land, waterways, and ocean resources and greater pressure to develop wildlands that now provide key wildlife habitat, all of which involves more work for state wildlife managers.

Expanding Responsibilities and Demands for Wildlife Conservation

CDFW is the state agency charged with conserving and restoring wildlife and ecosystems, responsibilities that have expanded and become more complex over the last several decades. Responding to the increasing problems affecting species and habitats, state policy-makers have enacted new wildlife conservation and environmental protection mandates. Without a broad-based reliable funding mechanism, CDFW is hard-pressed to implement many of these conservation programs, even at modest levels. Resource assessment, conservation planning, and dozens of tasks necessary to conserve wildlife species at risk are severely underfunded.

The problem of inadequate funding for wildlife conservation has been 40 years in the making. In light of the growing stresses on wildlife, CDFW has appropriately evolved from primarily managing fishing and hunting programs to serving as the public trust steward for all wildlife, habitat, and ecosystems, while continuing to manage fishing and hunting programs. With the enactment of more than 20 conservation programs since 1968, CDFW's wildlife and wildlands stewardship role has expanded dramatically above its statutory and regulatory responsibilities. Many of these measures have mandated major new workloads for CDFW without providing new or sufficient funding and staffing. Lack of funding to perform the required mandates was recognized as one of seven key findings from the SWAP 2005 implementation report (Appendix I).

CDFW's ongoing statutory and regulatory responsibilities include, but are not limited to:

- enforcing and promoting voluntary compliance of fish and game regulations;
- providing hunting and fishing opportunities based on sound science;
- operating 23 hatcheries, stocking almost four million pounds salmon, steelhead, and trout;
- conducting scientific assessments of our fish and wildlife populations;
- developing and implementing strategies to manage wildlife disease and responding to potential outbreaks of disease (e.g., adenovirus, duck viral enteritis, botulism, chronic wasting disease);
- evaluating lands considered for acquisition for benefit of wildlife and fish resources;
- directly managing more than a million acres as wildlife and ecological reserves;
- working with public agencies, landowners and other private interests to develop NCCPs;
- developing and managing numerous partnerships that will establish a comprehensive approach to managing the recently completed network of MPAs under the MLPA;

- protecting vulnerable species through project review, CESA listing and permitting, CEQA, Timber Harvest Plan Review, Mitigation Banking, Climate Change Initiatives (such as Drought Response), and Cap & Trade Carbon Sequestration programs, and LSA Agreements;
- working to control and prevent invasive species infestations;
- managing and restoring wetlands;
- coordinating and integrating CDFW's activities related to water rights, water quality, Federal Energy Regulatory Commission hydroelectric permitting, in-stream flow, Central Valley water operations, and the California Water Plan;
- responding as Lead agency for pollution spill prevention and response through both CDFW's Office of Spill Prevention and Response (OSPR) and inland pollution response;
- advising local governments, various commissions, and working groups regarding biological, technical, and conservation issues;
- working with individuals and government agencies to resolve depredation problems and other wildlife conflicts, an increasing challenge due to growth and development in rural communities and natural areas and expansion of agricultural activities;
- educating the public on fish and wildlife conservation and wildlife public safety issues;
- serving as the principal public contact for wildlife issues in the state; and
- issuing permits and licenses along with public information and education materials.

In addition to ongoing CDFW conservation responsibilities, in recent years, dozens of major new projects and programs have increased demands on CDFW. They include:

- The CDFW Ecosystem Restoration Program (ERP), in coordination with USFWS and National Marine Fisheries Service (NMFS), has finalized a Conservation Strategy for restoration of the Sacramento-San Joaquin Delta, Sacramento Valley and San Joaquin Valley regions. The Conservation Strategy describes ERP goals and conservation priorities for restoration and provides the rationale for potential restoration actions. ERP staff is coordinating with the Delta Science Program, Delta Conservancy, DWR, and other agency staff to ensure consistency of their respective adaptive management efforts with the Delta Plan, and in the development of coordinated Delta-wide restoration monitoring plans, performance measures, and evaluation and reporting programs.
- In 2009, the California Legislature passed the Delta Reform Act, which set in motion new planning efforts to achieve the co-equal goals of water supply reliability and a healthy Delta ecosystem and created two new state agencies, the Delta Stewardship Council (DSC), and the Sacramento-San Joaquin Delta Conservancy (Conservancy). The DSC finalized its comprehensive management plan for the Delta (Delta Plan) on May 17, 2013. The DSC convened its Implementation Committee, made up of state and federal agency directors and regional administrators to foster agency coordination in implementing the Delta Plan. The Final Delta Science Plan was accepted by the DSC on October 25, 2013. CDFW is working closely with the Delta Science Program in developing its Science Action Agenda for the

held in April 2014. The SWRCB is expected to make a final decision on Phase 2 Delta flow standards and associated objectives in 2016.

- The SWRCB utilized the Delta Science Program to complete an evaluation of methods to develop flow criteria for the Sacramento River and tributaries. The SWRCB plans to release a strategy for establishing flow criteria for Delta tributaries in fall 2015. In addition, CDFW and the SWRCB are coordinating on priority streams that are tributaries to the Delta and have begun the studies for determining the necessary flows. Currently, CDFW is conducting flow studies on lower Butte, Deer, and Mill creeks, all tributaries to the Sacramento River that have habitat for listed anadromous salmonids including spring-run Chinook salmon and steelhead. The studies will result in flow recommendations that CDFW will submit to the SWRCB.
- Marine Protected Area Monitoring and Management: CDFW is responsible for managing California's redesigned MPA network which includes 124 MPAs and 15 special closures, covering approximately 16 percent of the state waters (over nine percent of which is in no-take MPAs). CDFW collaborates with key partners to provide oversight on all aspects of MPA monitoring to inform adaptive management, including developing monitoring plans to apply the statewide MPA monitoring framework, regional baseline monitoring programs, five-year monitoring and management reviews and cost-effective continued monitoring programs based on results from baseline programs. CDFW continues to explore MPA effects on California's fisheries, maintains an interactive spatial marine and coastal data viewer called MarineBIOS and conducts field investigations such as remotely operated vehicle projects. CDFW MPA Outreach Coordination Project continues efforts to enhance public awareness and understanding of California's coastal network of MPAs. These efforts include:
  - collaboration with the California Department of Parks and Recreation (California State Parks) to develop an MPA component for three existing Parks On-line Resources for Teachers and Students (PORTS) programs. PORTS uses video-conference technology and downloadable lesson plans to teach academic content standards. Through this collaboration, CDFW will educate between 10,000-20,000 California K-12 grade-school students about MPAs in the 2014-15 academic year;
  - redesigned and updated guides and brochures for all four of California's regions;
  - collaboration with a variety of partners;
  - participation in the MPA Community Collaboratives; and
  - statewide MPA signage project.

  For additional information on MPAs, please visit http://www.dfg.ca.gov/marine/mpa/; for regional guides and brochures visit http://www.dfg.ca.gov/marine/mpa/mpa_summary.asp.

- Conservation and Mitigation Banking: In January 2013, the Conservation and Mitigation Banking program was established. New FGC sections 1797-1799 authorize CDFW to charge fees to cover reasonable costs for reviewing and approving bank-related documents. The fees support program staffing and contribute to the establishment of conservation and mitigation banks that protect critical fish and wildlife resources while enhancing partnerships

proposed Conservation Hatchery site at the San Joaquin Fish Hatchery to support salmon experiments and fish reintroduction. The SJRRP received a 2011 Partners in Conservation Award from the U.S. Secretary of the Interior for outstanding conservation, collaboration, cooperation and communication achievements.

Resources Needed for Regional Planning

Constant conflicts between development projects and protection of endangered species have led conservation scientists, stakeholders, and CDFW to recognize the value of regional planning for habitat conservation and protecting biodiversity. The goals of these broader proactive approaches to conservation are to identify and protect key habitats and designate areas more appropriate for development well in advance of planning for individual projects in a region. CDFW serves numerous important functions in these broader conservation efforts, providing:

- biological data on individual species, which is then used to develop multispecies conservation plans, recovery programs, and restoration projects;
- habitat quality and resource assessments, used to identify the most important lands for supporting multiple species;
- planning and design expertise for conservation planning projects;
- design of appropriate mitigation measures for effects of development on natural resources;
- facilitation in bringing diverse stakeholders to the table and assisting them in developing conservation strategies at the local government level; and
- monitoring implementation of conservation plans and mitigation projects to assess the effect and effectiveness of the implementation.

These responsibilities are not in lieu of work at the species level. It is the species-level research and management, and particularly implementation of CESA, which trigger efforts that evolve into the broader conservation planning efforts.

Wildlife Conservation Funding Crisis—Recognized but Not Solved

The fiscal difficulties of CDFW have been repeatedly acknowledged by the Legislature but not solved. The Legislature described the problem in statute in 1978, 1990, and 1992, as noted in the FGC sections below. In addition, FGC sections 711(a) and 711.4 describe funding for nongame fish and wildlife programs, managing lands, and defraying the costs of managing and protecting fish and wildlife trust resources.

FGC Section 710

The Legislature finds and declares that the department has in the past not been properly funded. This lack of funding has prevented proper planning and manpower allocation. The lack of funding has required the department to restrict warden enforcement and to defer essential repairs to fish hatcheries and other facilities. The lack of secure funding for fish and wildlife

activities other than sport and commercial fishing and hunting activities has resulted in inadequate non-game fish and wildlife protection programs. (Added to statutes in 1978.)

FGC Section 710.5

The Legislature finds and declares that the department continues to not be properly funded. While revenues have been declining, the department's responsibilities have been expanding into numerous new areas. The existing limitations on the expenditure of department revenues have resulted in its inability to effectively provide all of the programs and activities required under this code and to manage the wildlife resources held in trust by the department for the people of the state. (Added to statutes in 1990.)

FGC Section 710.7

The department continues to face serious funding instability due to revenue declines from traditional user fees and taxes and the addition of new program responsibilities. (Added to statutes in 1992.) The fiscal situation has worsened in recent years. Since 2001, the state budget crisis has compounded the funding challenges at CDFW. Wildlife and marine conservation programs, which are the primary beneficiaries of the limited General Fund dollars, have suffered dramatic budget cuts. General Fund support for CDFW dropped substantially during the recent budget crisis and has just recovered in 2015 to pre-crisis levels although workload and unfunded mandates have increased over this same period of time without concomitant budget augmentations.

FGC Section 711(a)

It is the intent of the Legislature to ensure adequate funding from appropriate sources for the department. To this end, the Legislature finds and declares that:

(1) The costs of nongame fish and wildlife programs shall be provided annually in the Budget Act by appropriating money from the General Fund, through nongame user fees, and sources other than the Fish and Game Preservation Fund to the department for these purposes.

(2) The costs of commercial fishing programs shall be provided out of revenues from commercial fishing taxes, license fees, and other revenues, from reimbursements and federal funds received for commercial fishing programs, and other funds appropriated by the Legislature for this purpose.

(3) The costs of hunting and sportfishing programs shall be provided out of hunting and sportfishing revenues and reimbursements and federal funds received for hunting and sportfishing programs, and other funds appropriated by the Legislature for this purpose. These revenues, reimbursements, and federal funds shall not be used to support commercial fishing programs, free hunting and fishing license programs, or nongame fish and wildlife programs.

(4) The costs of managing lands managed by the department and the costs of wildlife management programs shall be supplemented out of revenues in the Native Species Conservation and Enhancement Account in the Fish and Game Preservation Fund.

(5) Hunting, sportfishing, and sport ocean fishing license fees shall be adjusted annually to an amount equal to that computed pursuant to Section 713. However, a substantial increase in the aggregate of hunting and sportfishing programs shall be reflected by appropriate amendments to the sections of this code that establish the base sport license fee levels. The inflationary index provided in Section 713 may not be used to accommodate a substantial increase in the aggregate of hunting and sportfishing programs.

FGC Section 711.4

(a) The department shall impose and collect a filing fee in the amount prescribed in subdivision (d) to defray the costs of managing and protecting fish and wildlife trust resources, including, but not limited to, consulting with other public agencies, reviewing environmental documents, recommending mitigation measures, developing monitoring requirements for purposes of the California Environmental Quality Act (Division 13 (commencing with Section 21000) of the Public Resources Code), consulting pursuant to Section 21104.2 of the Public Resources Code, and other activities protecting those trust resources identified in the review pursuant to the California Environmental Quality Act.

7.3.2 Wildlife Conservation Program Needs

Fishing and hunting programs and related conservation efforts have specific dedicated funding derived from licenses, fees, and taxes on outdoor equipment. The public-trust duties of CDFW and its conservation programs that broadly benefit species, habitats, and ecosystems warrant funding from all Californians. Conservation-related activities that should be supported by broad-based funding may be described within the following four categories:

Science and Planning

- Managing and conducting resource assessment
- Implementing ecological research that supports conservation and management
- Developing regional conservation plans

Wildlife Conservation and Habitat Restoration

- Implementing conservation and recovery plans and projects.
- Designing, implementing, and monitoring habitat restoration projects
- Developing conservation and recovery strategies and plans

Enforcement for Wildlife, Wildlands, and Marine Resources

- Expanding wildlife and marine enforcement staff, salaries, and resources
- Developing an investigator class of wildlife enforcement staff

Wildlife Conservation Education and Service

- Educating the public on wildlife conservation issues
- Providing interpretive information and public services related to outdoor activities

7.3.3 Wildlife Lands Management Needs

State and federal wildlife and land management agencies and some state policy-makers have expressed great concern for the lack of resources for wildlife conservation, restoration, and enforcement on public lands. The needs for operation and maintenance of lands managed by CDFW are discussed below. USFWS, BLM, USFS, the National Park Service, and California State Parks have similar challenges to fund the restoration and management of wildlife areas, parks, and other wildlands. CDFW manages wildlife areas, ecological reserves, and wildlands specifically for the benefit of wildlife and important habitats. These lands are a cross section of California's remarkable natural diversity of animals, plants, habitat types, and ecosystems. Some of the state's finest-quality wildlife habitats are represented in these holdings. But acreage of lands managed by CDFW has quadrupled in the last 35 years, from 250,000 acres in 1980 to over 1.1 million acres today, and funding to manage these lands has not kept pace. Major bond acts and some appropriations have funded acquisition of new lands for wildlife, but there is not a corresponding source of funding to maintain, restore, and manage these lands. Land management entails providing site security, managing public health and safety on the lands, managing wildlife and natural resources, maintaining infrastructure, and managing recreation and other uses.

The consequences of neglecting lands are many:

- An area that is not secure or regularly inspected invites trespass by individuals and livestock and encroachment by such adjoining land uses as agricultural operations and off-road vehicles. Trespassing often involves vandalism and dumping. The result is degradation of the land, and the state is seen as a bad neighbor.
- Without management, wildlife values of the lands are also compromised. The habitat is degraded if invasive species are not controlled, fire is not managed, and ecosystems functions are not maintained.
- Lacking restoration efforts and/or management, many acquired lands do not meet the habitat goals for which they were purchased.
- Many lands have major public-use and education potential that cannot be realized without staff resources.

State wildlife lands have been acquired for specific conservation or recreation goals. Managing lands for their intended purpose requires staff and resources. Depending on the intended purposes of the land and the habitat values, CDFW's Lands and Facilities Branch Program estimates annual land operating management costs for many wildlife areas to range from $16 to $100 per acre. Local agencies estimate land operating and management costs to be significantly

higher. 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 and one staff person per 10,000 acres. Many lands were operated at $1 per acre, with no dedicated staff (CDFW Lands and Facilities Information Sheet).

7.3.4 New Funding Options

California is not unique in its difficulties with establishing an adequate and reliable revenue source for its wildlife conservation department. Numerous other state wildlife departments that have also evolved from fishing and hunting management organizations to expanded conservation organizations are also struggling to secure additional and more reliable funding.

Federal funding accounts for about 12 percent of CDFW's budget. Federal funds are provided through several programs, including the USFWS's programs pursuant to Section 6 of the ESA, the federal SWG Program, programs pursuant to the Sport Fish and Wildlife Restoration Acts, wetlands grant programs of the U.S. Environmental Protection Agency (EPA) and USFWS, and grant programs provided pursuant to the Clean Water Act.

Most state wildlife departments, in addition to receiving federal funding, are funded by a combination of user fees; a few tap into general sales-tax revenues. State wildlife department funding mechanisms include non-consumptive user fees, state lottery revenue, general sales tax, vehicle license plate fees, real estate transfer fees, tax check-offs, and natural resource extraction surcharges.

California's Environmental License Plate Fund Program generates funds for environmental and natural resources departments; however, these funds are usually appropriated to CDFW in lieu of General Fund dollars rather than to augment the base budget. In California, some of the better-funded resource departments and water agencies have funded a CDFW position to ensure certain wildlife-related services are provided. This funding source has been declining in recent years.

The 2014-2015 budget bill was signed on June 20, 2014. CDFW saw an increase of $1.5 million to regulate and enforce unauthorized water diversions and pollution to surface and groundwater as a result of marijuana cultivation. There is also the expansion of an existing per barrel fee on oil to account for crude oil entering in the state via rail, pipeline, and other modes that will fund a program for inland spill prevention and response. California has seen a significant shift in crude oil imports coming in over land rather than by sea. This fee will be collected at the refinery, making the fee equitable across various methods of importation. Currently, OSPR fund sources cover tidally influenced waters only, and cannot be used on inland spills. The budget contains an appropriation of $38.8 million for drought response actions, consistent with State of Emergency proclamations issued by the Governor in January and April. The budget also includes $25 million from Cap-and-Trade Program funds from the California Air Resources Board to implement wetland projects that reduce greenhouse gas emissions.

Arkansas and Missouri have two of the better-funded state wildlife programs. Both of these states have constitutional mandates that devote a percentage of general sales tax dollars to wildlife conservation. In 1976, Missouri enacted a constitutional amendment that raised the sales tax by one-eighth of a cent, generating about $70 million annually for wildlife management and conservation projects. In 1996, Arkansas enacted a similar constitutional amendment, which yields about $20 million annually for wildlife programs.

In 1991, the California Legislative Analyst's Office identified several user or impact fees that have a connection to wildlife and might be assessed to fund CDFW. They are:

- Motor-vehicle and highway impact fees—Vehicles and the highways affect wildlife in several significant ways. Road kills account for substantial mortality of many species, including deer, owls, and snakes. More deer are killed by collisions with vehicles than by hunting. Habitat is eliminated and fragmented by roads and highways. Oil and other chemicals from roads pollute aquatic ecosystems. And invasive species are often introduced along highways. Impact fees could be assessed as an increase in sales tax on vehicles sales, or a flat-rate surcharge could be attached to vehicle registration fees. Assessing an additional $1 per vehicle registration would generate approximately $26 million. Another option is a surtax on vehicle fuels. The California Constitution allows gasoline tax dollars to be used for environmental mitigation related to construction and operation of roads and highways.
- Nonpoint source discharge fees—Pollution from diverse sources runs off into wetlands and aquatic ecosystems. Those who create nonpoint source discharges could be assessed a fee to mitigate wildlife conservation impacts.
- Water use fees—Water diversions from rivers, streams, and the Delta significantly affect fish, amphibians, and aquatic life. To mitigate these effects, the Legislature could impose a water use fee on each acre-foot of water to fund wildlife conservation. A penny per acre-foot would generate about $220,000.
- Wastewater discharge fees—Pollution from industrial point sources degrades fish and aquatic life. Dischargers currently pay a fee that funds the SWRCB's water quality regulatory program.
- Recreational fees or taxes—Currently, only hunting and fishing recreational users pay annual fees for a license. Additional user fees could be assessed for other wildlife-related user activities, including birding, diving, and whale-watching.
- Mining fees—Gravel and open pit mining affects wildlife. For example, gravel mining from streambeds degrades salmon spawning grounds and degrades aquatic habitat. To fund wildlife conservation mitigation, a fee could be charged per volume of material removed. Broad-based fees or taxes, such as a flat-tax surcharge on annual state income tax, a parcel tax or parcel transfer fee, or a percent of sales tax, are in line with the policy that wildlife is a public trust resource and the responsibility of all Californians. If California followed the Missouri and Arkansas examples and enacted a one-eighth of a percent surcharge on sales tax, it would generate about $650 million for wildlife conservation and management of natural resources.

In April 2015, the Governor provided a new dual approach to improving water conveyance and ecosystem health in the Sacramento-San Joaquin Delta through two projects – California WaterFix and California EcoRestore. Habitat restoration actions (30,000 acres of restoration over a five-year period) to support the long-term health of the Sacramento-San Joaquin Delta's native fish and wildlife will be funded by the following:

- Floodplain and tidal/sub-tidal habitat restoration required by existing regulatory frameworks will be funded by state and federal water contractors;
- Wetlands restored for subsidence reversal and carbon management will be supported by the AB 32 Greenhouse Gas Reduction Fund and other sources;
- Various aquatic, riparian, and upland restoration and multi-benefit flood management projects will be supported by Proposition 1 and 1E; and
- Additional projects will be supported by various local and federal partners.

7.4 Coordination with Partners

Effective fish and wildlife conservation necessarily involves collaborative efforts among many partners, including other state agencies, federal agencies, tribes, nongovernmental organizations, local government, universities, landowners, and the private sector. Element 7 of the Eight Required Elements of a SWAP includes "coordinating, to the extent feasible, the development, implementation, review, and revision of the Action Plan with Federal, State, and local agencies and Indian tribes that manage significant land and water areas within the state or administer programs that significantly affect the conservation of identified species and habitats." Ongoing coordination will be a key component of SWAP 2015 implementation.

Key state and federal agencies that have been and/or are expected to be potential partners are listed below.

Key California Agencies with Natural Resource Responsibilities

- California Natural Resources Agency
- Department of Water Resources
- State Water Resources Control Board
- Wildlife Conservation Board
- Department of Forestry and Fire Protection
- Department of Parks and Recreation
- California Energy Commission
- Department of Transportation
- California Environmental Protection Agency
- California Coastal Commission
- State Conservancies (various)

APPENDIX IV A Bit About Mountain Bikers' Behavior: the Good and the Bad

Appreciation is due for those mountain bikers, including those in SDMBA's Local Stewardship Teams (https://www.sdmba.com/local_stewardship_teams.php), who diligently assist in the designing, building, and/or maintenance of officially designated trails on and off conserved lands (notwithstanding that, in some cases, the landowners should not have allowed some or any of the trails). These volunteers' contribution of 1,000s of hours dedicated to the management of the lands in this manner is sorely needed, given the shortage of resources available to the jurisdictional (e.g., County of San Diego) or agency (e.g., CDFW, USFWS, USFS) landowners and managers who bear ultimate responsibility for the lands. It is also appreciated that SDMBA does not work on non-system (i.e., unauthorized) trails; as they say, they shouldn't, but they don't control SDMBA members who do. (minute 68 into the video at https://www.facebook.com/SDMBA/videos/10155092539971172/?type=2&theater - refer to footnote 36). Too, recognition is due of bikers who follow the dictum of "leave no trace," though leaving no trace is infeasible for any recreational or other human activities on conserved lands.

Unfortunately, these bikers' goodwill is besmirched by two aspects of some mountain bikers' behavior.

The **first** aspect is the disinterest in and disrespect for the primary purposes of Ecological Reserves (ERs) and other conserved lands. An example of this is SDMBA webpage at https://sdmba.com/cdfw_lands_and_trails_access.php about nine of CDFW's ERs and one of CDFW's Wildlife Areas in San Diego County. The website states, in part, "CDFW to date has taken no official action which will assist in managing these properties and in many cases has refused to allow access to the public and key properties throughout the County" (emphasis added). Along with the frustration at not having legal access to some of these lands, this also reflects (a) a dismissal of the primary purpose of ERs as distinguished from some other types of conserved lands (refer to Appendix V for information about ERs), and (b) no understanding that habitat fragments in urbanized settings are often already compromised at the time of being conserved. With respect to management, this statement is not entirely correct – CDFW has provided varying levels of management on each of the properties; nevertheless, the underlying frustration about management shortfalls is warranted and shared by many, perhaps not understanding the reasons for the shortfalls.

The **second** aspect is the damage from some bikers' creation and use of unauthorized trails on both public and private lands, namely conserved lands on both. It is said that only a small percentage of mountain bikers (aka rogue bikers here) participate in these illegal activities. This is hardly reassuring, given the geographical extent and serious ecological impacts of the offenses involved; these offences and impacts include:

- initial removal of sensitive habitat sometimes supporting sensitive plants (including listed species);
- dislodging and compacting the soil;
- establishing conditions conducive to long-term erosion and downstream contamination;
- negatively affecting wildlife at the time of habitat removal and during continual trail use;
- fragmenting (or further fragmenting) the landscape; and
- fomenting further unauthorized trail creation and use by modelling that this behavior is accepting.

Further, rogue bikers trespass onto and vandalize conserved lands by removing signage, fencing, and cameras (SANDAG, 2015; Greer, Day, & McCutchen, 2017), to the degree that management is forced to become enforcement. Signage is sometimes vandalized within hours of being erected.

In-person communications with some riders and blog posts by riders who use unauthorized trails that have been around for years reflect their belief that they are entitled to, have prescriptive rights to, ride what they consider legacy trails. Some riders believe that, if they did not create the trails, they should be

able to ride them with impunity, specifically without being cited (Greer et al., 2017).

An egregious example in San Diego County of these behaviors is the approximately 50 miles of unauthorized trails created on the 430-acre Carlsbad Highlands Ecological Reserve (CHER) in the City of Carlsbad (Keltz, 2018).[43] Other conserved lands in San Diego County severely affected by unauthorized trails include, but are not limited to, Del Mar Mesa Preserve in the City of San Diego, Meadowbrook Ecological Reserve[44] in the City of Poway, and Sycamore Canyon / Goodan Ranch Preserve in unincorporated San Diego County.

The creation and use of unauthorized trails reflect arrogance, ignorance, and a blatant disregard for the applicable laws and regulations, resources, landowners and land managers, and those who care deeply about the resources that the conserved lands support. Some in the biking community recognize this, as the following examples reflect to varying degrees.

1. SDMBA's awareness of mountain bikers' sullied reputation is evident in an April 4, 2018, post by its Executive Director that states in part: "Over the past six weeks or so, I have been getting fairly regular reports from many of our agency and jurisdictional partners about illegal trail building and riding around the county. This activity is suddenly very widespread. Some in North County, some central, some in East County and some in the South. Blame it on springtime, blame it on new folks in town, blame it on kids, but mostly blame it on ignorance and selfishness" (emphasis added, https://sdmba.com/time_to_look_at_the_big_pictur.php).

2. SDMBA's article at https://sdmba.com/building_unauthorized_trails_j.php addresses the political fallout of unauthorized trails (SDMBA, 2018).

3. Starting at minute 8:45 in the video at http://www.sdmba.com/trail_building_and_maintenance.php, a volunteer from Carlsbad explains that his goal for the volunteer effort being filmed (bike path upgrade in Florida Canyon, City of San Diego) is to show that the mountain biking community is not the enemy; he explains that the mountain biking community has gotten a deserved bad rap for building unapproved trails and trespassing.

4. In an online article about unauthorized trail building and riding, City MTB (a mountain biking advocacy organization in Minnesota) states, "It may be public land, but public land isn't a free-for-all, it belongs to all of us and we have created government units to manage that land for us as a collective" (City MTB 2018, emphasis added).

Unfortunately, this recognition within the mountain biking community of the rogue bikers' aberrant behavior doesn't manifest in the community's active on-the-ground opposition to it, at least not in San Diego County. In fact, SDMBA's Trails Coordinator (SDMBA's Board Vice President at the time), indicated that SDMBA's emphasizing to rogue bikers that what they do is wrong and illegal won't translate to anything on the ground until there are adequate opportunities for biking; he also indicated that enforcement is only going to work as long as it is occurring, and when it stops the bikers will resume unauthorized activities (B. Stone, personal communication, March 28, 2018, phone call).

43 Appendix V provides some details about CHER.

44 https://www.wildlife.ca.gov/Lands/Places-to-Visit/Meadowbrook-ER The website at https://www.trailforks.com/trails/ted-williams/ about the Ted Williams Trail marks (with the green dot) the trailhead at the western terminus of Meadowbrook Lane; it appears that the blue line trail lies within Meadowbrook ER. At least one concerned citizen has been documenting the damage from the creation and use of unauthorized trails and TTFs.

There are times when rogue bikers' attitude presents itself in threatening or bullying statements. Examples follow; several refer to the video at https://www.facebook.com/SDMBA/videos/10155092539971172/?type=2&theater (refer to footnote 36). *Italicized text represents paraphrasing.*

1. In 2017, SDMBA threatened to file a complaint with CA Fish and Game Commission because CDFW does not allow mountain biking on CHER; SDMBA backed down from its plan.
2. Starting around minute 35 into the video, SDMBA's Stone explains that his original pitch to the USFS was that bikers are going to return to the trails that the USFS decommissions, tear them open, undo the work, and find a way to access the area that they have been using for 20 years; so, now the USFS wants to work with the mountain biking community.
3. At minute 39 into the video, an audience member says, *if we don't have the types of trails that we "need to ride, we're gonna do what we need to do to ride what we want to ride." There are a few of us here who are downhill racers – we don't have anything in San Diego to ride… [basically] we need to work with you guys to get what we need so we can train for the downhill competitions*. Comments like these reveal the entitlement some mountain bikers feel to use any open space areas they wish to, especially if they have been doing so for years. Such statements conflict with the claim that mountain bikers are stewards of the public lands. Their need for open space areas does not equate to stewardship for the land. This speaker's words are remarkably alarming in that, just 22 minutes prior (~ minute 16:30 into the video), another audience member had asked about a road that's been on a map for years and Heiar (USFS Descanso District Ranger) explains that *a road being on a map does not convey legal easement rights, so those private landowners have never sold or given up their legal right to someone else to cross their property, so while a road has existed in that location for decades or even a century, that does not negate that there is no actual legal access for the public to use that road. … It's a private road that was used historically by the public.* There are no such things as legacy trails or entitled rights to unauthorized trails. Trespassing is trespassing.
4. With 50.44 minutes remaining of the video, an audience member says [based on the context, presumably twisting his first words here], *it's the exception rather than the norm that people engaged in any sort of trail building are really interested in ecology, they are really interested in preserving that; we also recognize that a skinny mountain bike has a totally different impact on the environment versus a strip mall or something of that magnitude. With that in mind, we all want to be good stewards of the land and enjoy it and all those sorts of things, … when you use the word sustainable, what features is the USFS looking at with regard to sustainability?* It's concerning that Heiar responds by identifying ONLY soil erosion and long-lasting features that don't require ongoing maintenance, and mentioning IMBA as being in the forefront of trail building design, telling the audience to read IMBA's books. To the audience member's first point, it conflicts with the attitude aired in the room prior to his speaking. His second point reflects a misunderstanding on several levels of how projects are processed (depending on lead agencies and prevailing legal requirements) and their relative ecological impacts.
5. The often-heard warning that, when trails are closed to bikers, they will just go elsewhere to create and/or ride unauthorized trails. At minute 59 into the video, Heiar says that bikers building trails they want if the ones they want are not provided is not unique to this area. He needs to know exactly what riding experiences the riders need so that he can straight face it to the local Indian tribes – he needs to be able to assure the tribes that, if the trails needed are provided on USFS lands, the bikers will not create their own trails. The tribes have been concerned for a long time about bikers trespassing onto their lands (minute 67 into the video).

Some mountain bikers (and other recreationists) express the notion that they are the dispossessed victims in the dual challenge of protecting sensitive ecological resources and accommodating recreationists on conserved lands. The fundamental impetus underlying the protection of conserved lands is the need to protect plant communities and species many of which are endemic and /or listed as rare, threatened, or endangered (refer to footnote 9). If there are any victims in this challenge, they are these plant

communities and species which need these lands in order to persist. There is no logical analogy, similarity, or equivalence between the predicaments of humans trying to recreate and other species "trying" to survive. To suggest otherwise is disturbingly anthropocentric.

This is not to minimize the well-recognized importance of humans having time in nature, but rather to emphasize the importance of humans preventing or at least minimizing their ecological impacts on conserved lands and the sensitive species they support. Habitat loss caused primarily by development has been the major driver in the depletion of species' populations. The challenge is to accommodate other human actions (e.g., like recreation) on the very lands conserved to enable sensitive plant communities and plant and wildlife species to persist (and, ideally thrive).

It seems reasonable to assume that the impulse driving rogue bikers' behavior is self-interest. By contrast, with respect to lands conserved primarily to protect ecological resources, the interest of most landowners and managers and of conservation-minded organizations, professionals, and other individuals extends outside themselves, though indeed they benefit knowing that the ecological resources may be better off because of their efforts. This is not a matter of one interest being better or more moral, ethical, high-minded than another, but instead merely an observation.

The immediate personal gratification from serving one's self-interest enhances its attraction, salience, and power (Small and Loewenstein, 2003, as cited in Moore & Loewenstein, 2004). Moore and Loewenstein maintain that "the broader the acceptance for self-interested behavior, the easier it is for the mind to automate it and the less one has to think about it or even be aware of it" (p. 196). Presumably, this also applies the longer a self-interested behavior occurs.

The victims of self-interested behavior are often unknown, which makes it unlikely that sympathy will serve as a countervailing visceral impulse (Small and Loewenstein, 2003, as cited in Moore & Loewenstein, 2004). "Research has shown both that people are more likely to help and less willing to hurt specific individuals whom they know than individuals who are unknown and probabilistic (Latane, 1981; Small and Loewenstein, 2003)" (Moore & Loewenstein, 2004, p. 197). Moore and Lowenstein contend that the only way for the ethical principles that secure social cooperation to survive is for people to internalize social values, and that incorporating these values into education may be the way to obtain this internalization (2004). Interpreting this as also applicable to humans relationships with non-human animals suggests that providing rogue bikers knowledge about the species their actions may damage is necessary to modify their behavior.

The USFS-SDMBA Partnership

Here, the partnership between USFS and SDMBA is a proxy for all such collaboration between mountain biking advocates and Lead Agencies in San Diego County, though it is unknown to the author if there are others involving an advocacy group paying a Lead Agency for work on a project the group wants done.

SDMBA was already an effective advocacy organization before hiring its Trails Coordinator in August of this year (https://sdmba.com/sdmba_hires_trails_coordinator.php); it will presumably be more effective now. The USFS – SDMBA partnership epitomizes SDMBA's efficacy.

The webpages at the following links provide information about the partnership.

- https://sdmba.com/orosco_ridge_trails_plan.php
- https://www.fs.usda.gov/project/?project=53904
- https://sdmba.com/advocacy_meeting_minutes.php

At minute 49 into the video described in footnote 36, SDMBA's Stone explains that, because the USFS does not have a budget for recreation, the only way trails will happen is if SDMBA pays for the USFS staff time and studies needed to approve the trails. The USFS is up front about not having the adequate staff for trail work and about the need to forge working relationships with project supporters. At minute 18 remaining of the same video, the USFS Recreation Staff Officer-Descanso explains the USFS's heavy reliance on volunteers (both ultra runners and bikers) to maintain the trails and that dedicated volunteers have a stronger voice with her than a cold caller requesting a reroute.

SDMBA views USFS as a progressive agency, open to listening to the mountain biking community, unlike other landowners in San Diego County (at 51 minutes remaining of the same video). Of course, the USFS has much larger landscapes to work within. SDMBA particularly likes working with USFS and BLM because they are not subject to CEQA and they are willing to provide single use trails whereas the other land owners/managers generally require that trails be multi-use.

While the USFS-SDMBA 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. The Sierra Club's May 24, 2018, comment letter in response to the USFS's April 25, 2018 Scoping Letter about the USFS initiating a NEPA analysis for the Orosco Ridge Mountain Bike Trail System (File Code: 1950) addresses concerns about the conflictual nature of the partnership.

The USFS-SDMBA partnership poses a challenge because so much work is done outside of public view, prior to the public knowing anything about it. Where is the public process, other than the obligatory NEPA process commenced in 2018 with the circulation of a document for public review?

APPENDIX V The Primary Purpose of Ecological Reserves & Basic Info About CHER

CDFW owns and manages three types of lands - Ecological Reserves (ERs), Wildlife Areas (WAs), and other natural areas. ERs allow fewer public uses than WAs. The regulations and laws pertaining to ERs are straightforward. The process by which lands are considered for designation as an ER is deliberative and slow. ERs are rarely "mitigation" lands.

Title 14, California Code of Regulations (CCR)

§550(bb): Bicycles and bike riding are prohibited on department lands except where authorized and designated in subsection 551(j), Section 552, and subsection 630(g) of these regulations.

Subsection 551(j) pertains only to WAs.

Section 552 pertains only to National Wildlife Refuges that are also designated as WAs.

§630 ADDITIONAL VISITOR USE REGULATIONS ON DEPARTMENT LANDS DESIGNATED AS ECOLOGICAL RESERVES.

(a) ….. 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 commission that opening an area to such visitor use is compatible with the purposes of the property. Visitor use is subject to the regulations below, in sections 550 and 550.5 of these regulations, as well as any other commission regulations that may apply. These regulations are incorporated by reference into and become a condition of entry, passes, and/or permits. It is the responsibility of all visitors to know and understand these regulations prior to entry* [emphasis added].

(g) [As detailed on the table in this subsection, biking is authorized on 8 of 136 ERs statewide, and the biking is explicitly limited to designated trails. For ERs, biking is authorized only, though not always, on those ERs where biking occurred legally prior to the designation of the ER.]

* * * * * * * * * *

Carlsbad Highlands Ecological Reserve (CHER) in Carlsbad, CA., designated in 2000

CHER occupies 473 acres, 263 acres of which comprise the Carlsbad Highlands Conservation Bank (aka Mitigation Bank) and 110 acres of which comprise Calavera Heights Mitigation Site (aka Property). Both designations preexisted the designation of CHER, which added 100 acres to the conserved area. Thus, the land that comprises CHER has three layers of protection. Prior to its designation, biking was never authorized on the lands that comprise CHER.

Carlsbad's Habitat Management Plan (HMP) states about the Conservation Bank, "A mitigation or conservation bank is land that is permanently conserved and managed for its natural resource values, with the intent of selling mitigation credits to private or public entities requiring mitigation.... [this bank was] approved by the USFWS and CDFG in 1995..... [and] contains primarily upland habitats, including coastal sage scrub" (page D-10). The HMP states about Calavera Heights Mitigation Site, "In 1993 this approx. 110 acres parcel in northeast Carlsbad was purchased by the developer of Villages Q and T of Calavera Heights as mitigation for the impacts of constructing those two villages. Approximately $93,000 was deposited with the City to cover startup costs. A mitigation agreement between the City and the developer provides for the possibility of an endowment to cover long-term management **(**Mitigation Agreement dated March 15, 1993, between the City of Carlsbad and Lyon/Copley Carlsbad Associates). In 1998 the developer donated title to the mitigation parcel to The Environmental Trust (TET), a local non-profit conservation entity. An Open Space easement in favor of the City has been recorded. Management activities are now being carried out on a limited basis by TET utilizing the startup funding. Provisions for the long-term endowment will be considered within the next 2 years and will be incorporated into the final HMP Management Plan" (page F-6).