MOUNTAIN BIKING IMPACT REVIEW
FREQUENTLY ASKED QUESTIONS

MOUNTAIN BIKERS OF SANTA CRUZ

MOUNTAIN BIKING IMPACT REVIEW FAQ

This content was created by:
Mountain Bikers of Santa Cruz
MBOSC.org | info@mbosc.org
PO Box 331 , Santa Cruz, CA 95061

Photography provided by:
Bruce Dorman
Kyle Kelley
Josh Sawyer
Ian Stowe
Mike Thomas

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A natural resource recreation researcher

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info@mbosc.org

MOUNTAIN BIKERS
OF SANTA CRUZ

MOUNTAIN BIKING IMPACT REVIEW
FREQUENTLY ASKED QUESTIONS

This Mountain Biking Impact Review poses the most frequently asked questions concerning the social and environmental impacts of mountain biking and trail construction. Here we share our unbiased findings, which are based on a comprehensive literature search performed by the Mountain Bikers of Santa Cruz Science Committee.

WE HOPE YOU LEARN SOMETHING, WE SURE DID!

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ABOUT THIS PROJECT

ABOUT THE MOUNTAIN BIKING IMPACT REVIEW FAQs

These Mountain Biking Impact Review FAQs pose questions that we believe are the most frequently asked concerning the social and environmental impacts of mountain biking and trail construction. The answers to these questions were created based on a comprehensive literature search on the relationships of trails and recreational trail users (specifically mountain bikes, but also other user groups) and natural resources within the following topics: Hydrology and Geology, Plants and Wildlife, and Social Issues. We, the members of the Mountain Bikers of Santa Cruz science committee, are scientists, mountain bikers, hikers, and environmentalists in search of facts. In these Mountain Biking Impact Review FAQs we share our unbiased findings.
We hope you learn something, we sure did!

ABOUT MOUNTAIN BIKERS OF SANTA CRUZ

Mountain Bikers of Santa Cruz (MBOSC) is a 501(c)(3) non-profit organization that was founded in 1997 to support, preserve, and expand trail access and responsible mountain biking in Santa Cruz County. We have since become a highly skilled trail stewardship organization with expertise in advocacy, trail and bike park design, construction and maintenance, volunteer management, and project funding.

We are driven by passionate volunteers and high-caliber professional staff who promote legal and sustainable mountain bike access through trail construction, event promotion, and collaboration throughout the county. Strategic partnerships with land managers, other trail users, and the local bike industry help MBOSC build new trails and support sustainable trail use. MBOSC has proven to be an invaluable partner for local land managers, investing nearly $1,900,000, over 20,400 hours of staff time, and over 26,250 hours of volunteer time in trail construction and maintenance since 2012. During our 2017/18 trail work season, 398 volunteers and MBOSC staff performed 3,828 hours of trail work at our local State and City Parks and at Soquel Demonstration State Forest.

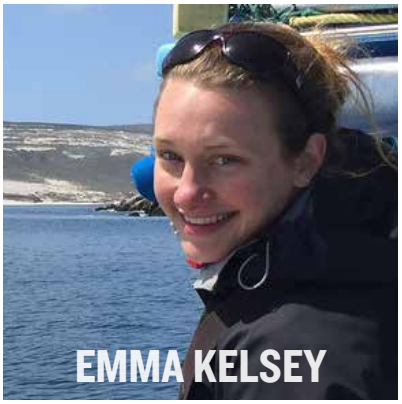
MBOSC is focused on furthering our mission to make Santa Cruz the best place to be a trail-user. With more opportunities to expand trail access in the county than at any point in history, MBOSC is planning to make the most of these opportunities.

ABOUT THE MBOSC SCIENCE COMMITTEE

Like most great ideas, the concept of the MBOSC Science Committee was created after a great day on the trails. Following a Wilder Ranch Dig Day in March 2017, MBOSC Executive Director Matt De Young, President John Leckrone, and emeritus Science Committee chair Dr. Meagan Hynes were discussing how Meagan's professional background in soil science could help inform how soil types in Wilder Ranch State Park related to erosion risk. This conversation led Matt, John, and Meagan to consider all the ways MBOSC members and the general public could benefit from a better understanding of the science behind trail construction and mountain biking environmental impacts. The MBOSC Science Committee was formed in October 2017.

MEET THE RESEARCHERS

The following members of the MBOSC Science Committee worked together to compile these Mountain Biking Impact Review FAQs:



Masters of Science, Wildlife Biologist

Masters of Environmental Science and Management, Applications Engineering and Spatial Analysis Consultant

Masters of Science, Geologist

Bachelor of Science in Chemical Engineering, Chemical Engineer

Bachelor of Science, Project Geologist, Petralogix Engineering, Inc.

Bachelor of Science and Planetary Science, Santa Cruz Bicycles Quality Control Inspector

MOUNTAIN BIKING IMPACT REVIEW FAQs

HYDROLOGY & GEOLOGY

1) DOES MOUNTAIN BIKING GENERATE MORE EROSION AND OTHER TRAIL DAMAGE THAN OTHER TYPES OF RECREATIONAL TRAIL USE? HOW DO PHYSICAL TRAIL IMPACTS DIFFER BASED ON USER GROUP?

- In general, studies have shown that there is no statistically significant difference in induced soil erosion, excavation, incision (ruts), and trail widening between biking and hiking, and both are far less impactful than horse riding.[1] [2] [3] [4] Erosion on trails depends more on trail design, water drainage, levels of use, and soil properties.[5]
- The degree of physical impact related to trails is mostly dependent on trail maintenance regime rather than type of use.[4]
- There are a handful of studies that have been conducted over the past couple of decades looking into the comparative physical impacts (e.g. trail compaction/ incision, trail widening, soil displacement and erosion) on trails by different user groups.[1] [2] [3] [4] The general conclusions of these studies are that:
  - On properly-built and well-maintained trails there is little to no measurable difference between the relative impacts caused by mountain bikes vs. hikers.
  - Although there are few quantitative studies on the topic, it is generally accepted that informal/user-built trails tend to experience dramatically elevated rates of degradation due to poor design, management, and construction practices.
  - Additional research is needed to more accurately measure the variation of mountain bike impacts based on riding style (e.g. XC, downhill, dirt-jumps, etc.).

2) WHAT ABOUT UNSANCTIONED (ILLEGAL) TRAILS AND FEATURES?

- User created trails are unplanned and don't undergo the rigorous environmental review and design that modern, sanctioned, official trails usually do.
- Unsanctioned technical trail features are fairly unique to mountain biking.[3] They are often built unsustainably and their impacts can spread beyond the immediate area when they fall into disrepair and riders create alternate paths. They may involve greater soil excavation, timber harvesting, importing of materials, and potentially greater amounts of garbage as a byproduct.[3]
- Trails and features planned and built under the direction of trail stewardship organizations (such as MBOSC), local land managers, or collaborations between the two, are more sustainable with minimized areas of impact.
  - In Perth, Australia, partners constructed a sanctioned technical trail system adjacent to a sensitive National Park which had been affected by illegal riding and trail building. The environmental impact on the National Park was significantly reduced after the adjacent bike park was completed, demonstrating the benefit of partnerships between land management and trail stewardship organizations in decreasing the negative impacts of unsanctioned trail use.[3]

3) I FREQUENTLY NOTICE RUTS IN LOCAL TRAILS. WHAT CAUSES THESE? DO THEY LEAD TO MORE EROSION? HOW CAN THEY BE ALLEVIATED?

- Ruts, soil displacement, and compaction are unavoidable outcomes of trail use over time. Whether by foot, tire, or hoof, soil is being excavated and forms ruts over time. If left unattended, the path will continue to erode from precipitation events.[6] [7] [8]
- Rut creation is accelerated when trails are wet, which is why riding trails during and following rain events is highly discouraged.
- Proper trail construction and regular maintenance under the guidance of trail stewardship organizations (such as MBOSC) greatly alleviate the effects of regular use.[6] [7] [8]

4) DOES TRAIL EROSION CAUSED BY TRAIL USERS LEAD TO SEDIMENT IN LOCAL STREAMS? HOW PROBLEMATIC IS IT?

- Soil displacement is an inevitable byproduct of trail construction and use. The severity of displacement and the potential for that soil to erode and find its way into waterways depends on many factors including soil type, trail design (grade, slope, drainage. etc.), water management, connectivity to a waterway, and degree and type of trail use.[2] [5] [6]
- The cardinal rule when designing and building a trail—no matter what type of users it is intended for—is to "keep the water off of the trail and keep the trail out of the water". This means that a sustainably designed and built trail should minimize the interaction between displaced trail-dirt and streams, and properly account for the factors that might increase erosion.[7] [8] [9] That said, poorly designed and built trails can certainly lead to more soil displacement and erosion, and a higher risk of sediment ending up in local streams.[2] [5]
- The majority of streams in our region are ephemeral and only see water during winter storms. Heavy rainfall during winter storms have high energy, cause landslides, and have the potential to transport sediment from small tributary drainages to waterways such as Laguna Creek or the San Lorenzo River.[10] Salmon and aquatic invertebrates depend on the rocky bottoms of these streams for survival. Therefore, loose dirt from human disturbance can potentially be damaging to the aquatic life, and the degree of impact from this runoff depends on the timing, volume and location.[11]
- Dirt roads, particularly the numerous poorly-maintained fire roads throughout the Santa Cruz region, are a significant potential contributor of sediment delivery to local streams, and specific management actions are in place to target these roads and reduce these impacts.[12] [13] There are few studies which attempt to quantify the volume of sediment delivery to streams from trails as compared to dirt roads.
    - One study from West Virginia modeled sediment in streams from various road and trail stream-crossings.[9] The researchers found sediment loads from un-improved trail stream-crossings to be 10 times greater than expected loads from an undisturbed forest. Sediment from fire roads with minimal improvements (water bars) was 200 times greater than an undisturbed forest. Sediment from

fire roads with significant erosion improvements (water bars, mulching, and brush cleared for fire mitigation) was similar to that of unimproved trails.

- The study did not model trails that were designed and built using best management practices for erosion and stream crossings. More research—particularly regionally appropriate studies and studies including appropriate trail design—is needed on this subject.

- While there is no doubt that some sediment generated by trail users (particularly on poorly designed and maintained trails) will ultimately find its way to local streams, the magnitude of this contribution—and its impact on aquatic life—is significantly less than that from un-maintained dirt roads, large rain storms, or landslide events.[11] [12]
  - Even so, our goal as trail stewards is to do what is in our power (e.g. trail design, maintenance, education) to minimize those impacts.[7] [8] [9] In addition to sustainable trail construction that reduces soil displacement, MBOSC has built bridges across major stream crossings to avoid direct impact of trail users on these streams.

5) WHAT CAN I DO AS A TRAIL USER TO MINIMIZE MY IMPACT TO THE TRAIL, SOIL, AND ADJACENT DRAINAGES?

- Stay on the designed pathway of the trail, avoid unsanctioned trails and off-trail features.[14] [15]
- Slow or stop for hikers and oncoming riders to allow sufficient room for them to pass. Trails get widened and trail-side vegetation is impacted more when hikers have to step aside for bikers.[2] [14] [15]
- Avoid muddy or excessively wet trails. A good rule of thumb is that if the trail is soft enough to leave tire tracks, it is also soft enough to be damaged by riders. Wait a day or two before you head back out.[14] [16]
- If there are mud puddles in the trail, carefully ride through them. Don't go around them since that will widen the trail.
- Likewise, if there are ruts in the trail, ride them. Don't go around since that will lead to trail widening.
- Avoid last-minute, quick braking as this can lead to ruts and accentuate trail damage. As much as skill and visibility allow, look down the trail, anticipate what is ahead, and check your speed ahead of time.
- Learn how to feather your brakes; don't skid your tires.

MOUNTAIN BIKING IMPACT REVIEW FAQs

PLANTS & WILDLIFE

1) GENERALLY SPEAKING, WHAT IS THE IMPACT OF MOUNTAIN BIKING ON WILDLIFE?

- The short answer is that it's complicated. It largely depends on the species encountered, the characteristics of the trail, and the conduct of the trail user.
- The creation and presence of human created trails may lead to the fragmentation of a landscape that was once intact.[1] [2] The effects of fragmentation on wildlife vary depending on the species and the scale of analyses and impact.[3] Fragmentation has been found to be more severe in areas where unsanctioned trails are common.[4]
    - For instance, Red-legged Frogs can be adversely impacted if a trail traverses within 100 meters of its habitat.[5]
    - Research has found that some bird species have decreased nest survival, increased predation, or lower nest density in areas fragmented by trails.[6] [7]
    - Other species, however, have been shown to use trails to their advantage for travel or foraging, demonstrating that the presence of trails can affect the local composition of species.[7]
- The trail user and that user's behavior also will dictate their impact on wildlife. Studies have shown that nesting birds may not be disturbed (e.g. the bird being startled from its nest/perch) by hikers or bikers quietly moving along a trail, but when trail users were noisy (e.g. talking) or when they stopped and/or approached the nest (e.g. birdwatchers), the likelihood of disturbance was significantly higher.[8] [9] [10] Most birds and mammals will react more strongly (i.e., flee) to off-trail recreationists than to on-trail users.[8] [9] [10] [11] [12]
- Research shows that noise can affect wildlife. Noise, however, is subjective and is perceived by different species in different ways.[13] [14] Studies have show that bicyclists passing quickly may cause less noise disturbance than other recreationalist on the trail.[11] [16] [32]
- A number of papers have attempted to synthesize the existing research of recreational impacts on wildlife worldwide. Findings show that a majority (>60%) of the studies reviewed demonstrated some form of negative impact on wildlife from all types of trail use (mountain biking, hiking, horseback riding).[16] [17] [18]
    - However, these same studies suggest that while recreational trail use may impact individual or groups of animals, population-level impacts to a species are less well-studied and poorly known.

2) HOW DO MOUNTAIN BIKES IMPACT WILDLIFE AS COMPARED TO OTHER TRAIL USERS?

- Many studies examined the impacts of recreation on wildlife by user type(s). The majority of these studies however didn't specifically address mountain biking, nor do they distinguish between the wide variety of mountain bike riding types (e.g. cross-country vs. downhill). The few studies that specifically addressed mountain biking have suggested the following:
    - Across a number of studies, researchers found that ungulates (such as deer and elk) are equally or less likely to be disturbed by mountain bikers than by hikers, joggers, or horseback riders.[11] [12]

- The negative effects of trail use on birds is equal across trail use types when users are quiet and continuously moving.[17] Birds tend to be more adversely affected when users stop along the trail, or when they make more noise.[8] [9] [10] [19]
- A study in a network of wildland reserves in Southern CA of disturbance to medium and large mammals found that all user types had negative effects, and that some types of human disturbance were more negative than others (from most to least impactful: pedestrian, bicycles, vehicles, dogs, equestrians).[20]
    - This study's researchers refer to these impacts as a form of "mortality-free predation" due to the fact that these animals preferentially avoid habitat that humans are a part of.

3) WHAT THREATENED OR ENDANGERED SPECIES ARE PRESENT IN THE SANTA CRUZ AREA, AND HOW DO MOUNTAIN BIKES AND TRAILS IMPACT THEM?

- There are numerous plants and animals in Santa Cruz county listed as threatened or endangered. These include: Red-legged Frog, Tiger Salamander, Long-toed Salamander, Marbled Murrelet, Steelhead & Coho Salmon, Mount Hermon June Beetle, Ohlone Tiger Beetle, Smith's Blue Butterfly, Zayante Band-winged Grasshopper, San Francisco Popcorn Flower, Santa Cruz Tarplant, Robust Spineflower, and San Francisco Dusky-Footed Woodrat.[21] [22]
- Threats to these species vary based on where they exist and how they respond to human disturbance.
    - Sedimentation in the San Lorenzo river and its tributaries is detrimental to salmon, a problem that can be made worse from erosion of poorly-built trails (see the Hydrology and Geology section, page 9). These impacts, as well as impacts to amphibians such as the Red-legged Frog[23] can be alleviated by proper trail construction and routing trails away from sensitive riparian areas.
    - The Ohlone Tiger Beetle (Cicindela ohlone) lives in coastal terrace habitat with open native grassland.[24] Historically it was known to exist in Pogonip Park and Moore Creek Preserve, but was last seen in 2004.[21] An increased awareness of trail users and regulation of mountain bike speed has been shown to have positive effects on the Ohlone tiger beetle on the University of California, Santa Cruz, campus.[25]
    - Sensitive plants such as the San Francisco Popcorn Flower, Santa Cruz Tarplant, and Robust Spineflower, are susceptible to trampling by off-trail users, and to the introduction of non-native species.[24] These impacts are mitigated by limiting off-trail use and by comprehensive vegetation surveys prior to any new trail construction or re-routing.

4) ARE THERE LINKAGES BETWEEN MOUNTAIN BIKES AND THE PRESENCE/SPREAD OF HARMFUL AND INVASIVE SPECIES? CAN MOUNTAIN BIKES SPREAD HARMFUL SPECIES MORE THAN OTHER TRAIL USERS?

- Sudden Oak Death (SOD) is known to occur in Santa Cruz County (suddenoakdeath.org). Hikers and mountain bikers don't differ in their ability to transmit the pathogen,

but research shows that the farther one travels on a trail, the higher the chance of encountering, picking up and distributing the pathogen.[26] Moist soil in shoes/tires can harbor live pathogens, whereas dried soil is less likely to re-infect, meaning washing shoe and tire tread of mud is critical in preventing the spread of SOD. Given the ability of recreationists to act as a vector in the transmission of SOD, public recreation lands tend to have higher incidence of SOD infected trees than do private lands closed to recreation.[26]

- Brown-headed cowbirds (who trick other birds into protecting and feeding their young, at the expense of the other species' own chicks) are known to be attracted to and use trails and open-corridors as access routes into forest interiors.[27] [28] [29 [30] However, other research on the subject did not find any relationship between cowbird abundance or nest exploitation and distance from trails.[7]
- In terms of invasive plants, trails and trail users can act as vectors and provide new opportunities for their spread. One study showed that the presence of invasive plant species decreased with distance from both trails and roads, and that invasive species cover was greater near unsanctioned trails. Due to the low sample size it is unclear whether trail type or distance from the nearest road was responsible for this trend.[31]

5) WHAT CAN I DO AS A TRAIL USER TO MINIMIZE MY IMPACT TO WILDLIFE AND THE ENVIRONMENT?

- When it comes to Sudden Oak Death, it is good to be cognizant of your tires' ability to transmit this disease and clean your tires when riding in a new place. Also, the wetter the soil, the easier it is for harmful passengers to hitch a ride on a shoe or tire. This is another reason why it is better to ride or hike trails that aren't muddy or excessively wet.
- Studies show that it's best to keep moving when out on the trails and to maintain conversation at low or moderate levels.
    - Especially if you're riding in the early morning or late evening, when local species (such as bobcats, coyotes, and deer) are more active, be mindful of your speed and volume and how it might affect wildlife.
- When you do see wildlife, do not approach it.

MOUNTAIN BIKING IMPACT REVIEW FAQs

SOCIAL ISSUES

1) USER-CREATED ILLEGAL MOUNTAIN BIKE TRAILS ARE POPULAR AND PROLIFIC IN THE SANTA CRUZ AREA. CAN EXPANDING THE NETWORK OF SANCTIONED BIKE TRAILS ALLEVIATE THE PROBLEM? OR WILL INDIVIDUAL TRAIL BUILDERS CONTINUE TO BUILD UNSANCTIONED TRAILS?

- The creation of unsanctioned trails is not just isolated to mountain bikers, and unsanctioned trails are a symptom of an unmet need for legitimate trail use options. There is a general lack of research attempting to quantify the degree to which sanctioned trail networks alleviate the illegal trail building.
    - Anecdotally, according to an outdoor recreation planner for the BLM, fewer rogue trails tend to appear when agencies work closely with local mountain biking groups rather than trying to manage an area alone.[1]

2) WHAT NUMBER OF LEGAL TRAILS ARE NECESSARY TO BUILD TO SATISFY THE DEMAND OF THE BIKING COMMUNITY NOW AND IN THE FUTURE? HOW WILL SANTA CRUZ COUNTY SUSTAINABLY BE ABLE TO ACCOMMODATE AND MANAGE THIS USER COMMUNITY?

- MBOSC is working to better understand this topic in Santa Cruz County through trail counting systems and collaborative projects with land managers and researchers.
- In Santa Cruz County, we have 220 miles of official single-track trails, of which less than 40 miles are open to bikes (this does not include fire roads).[2] The average rider in Santa Cruz County rides 15 miles per week and rides an average of 3 times per week.[3]

3) AS A MOUNTAIN BIKER, WHAT CAN I DO TO HELP REDUCE CONFLICT BETWEEN VARIOUS TRAIL USERS?

- Research indicates that interactions between mountain bikers and other trail users rarely generate conflicts on trails.[4] However, people riding mountain bikes are commonly perceived as a hazard to other trail users and this perception (more than actual interaction) can become a source of conflict.[5]
- Hikers and equestrians generally have safety concerns based on cyclist speed, cyclists not showing caution on blind corners, and cyclists surprising hikers and equestrians on trails due to the fact that they are comparatively quiet and are perceived to move more quickly.[6]
- While trail designers and land managers can play a large role in reducing multi-use trail conflict by designing trails with improved sight lines, passing opportunities, and adequate signage, it is the mountain biking community's interactions with other user groups that will shape perceptions of the sport and its user community. Mountain bikers can reduce potential conflict (or negative perceptions) while riding multi-use trails by:
    - Reducing speed well ahead of encountering other trail users. (A mountain biker may know how quickly hydraulic disk brakes will slow them down, but most hikers may not.)

- Slowing down on blind corners.
- Politely alerting other trail users on approach (e.g. using friendly verbal contact or a bike bell).

4) WHAT CAN WE DO WE KEEP OUR TRAILS SAFE AND AVAILABLE TO EVERYONE?

- It is imperative that mountain bikers be courteous, responsible, and acknowledge that they are members of the greater trail community. Popular perceptions are not in mountain bikers' favor, so the more we can do to dispel myths and help re-shape those perceptions, the better.
- For example, studies show that non-biking groups who actually encountered mountain bikers on trails had more positive opinions of mountain bikers compared with those who did not encounter mountain bikers.[4] [6]
  - We all use the trails for the common purpose of enjoying our beautiful environments, so the kinder and more communicative we can be with each other, the more enjoyment we will all get out of it.
- Reviews of conflicts on public lands indicate that the frequency of actual hazardous incidents between mountain bikers and other trail users is very low.[5]
  - Further research is warranted, but based on findings to date, actual incidents between mountain bikers versus hikers appears to be minimal.
  - MBOSC understands that a perceived safety conflict is still a significant issue, and we do our best as trail designers and stewards to address perceived and real safety concerns (such as facilitating positive social interaction, improving trail sight lines, and promoting the construction of user specified trails).

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ASK A QUESTION

Do you have another question to add to this list of Mountain Biking Impact Review FAQs, or would you like to submit more information on the topics covered in this document? Please contact the MBOSC Science Committee by visiting:

MBOSC.org/mtb-impact-faq_contact

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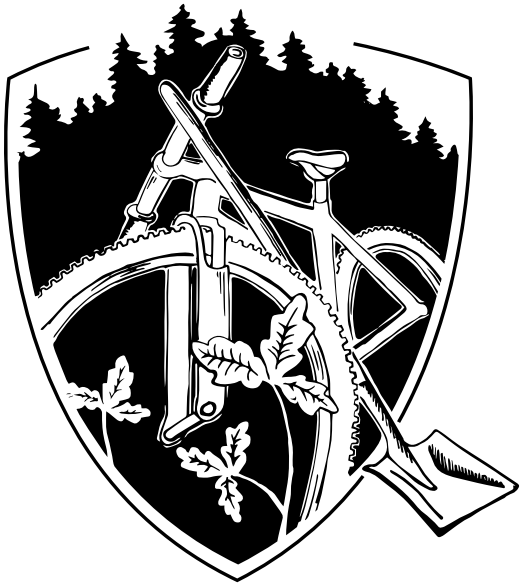

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